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BIOLOGICAL SOCIETY OF WASHINGTON

PROCEEDINGS

1037th Meeting—14 May 1965

EIGHTY-SIXTH ANNUAL MEETING

President Charles O. Handley, Jr., called the meeting to order at 2 p.m. with about 25 members present. The reading of the minutes of the last meeting and the reports of the Recording and Corresponding secretaries were suspended. Considerable discussion on the tax status of the society followed the report of the Treasurer, Henry B. Roberts. Application is being made to the Bureau of Internal Revenue for tax exemption.

The following new members were elected: Larry N. Brown, John S. Buckett, Donald W. Buden, J. F. Fitzpatric, Jr., Richard S. Funk, Michael R. Gardner, John Douglas Lynch, Paul M. Marsh, Robert L. Martin, John C. McCain, Jack R. Meyer, James A. Peters, William J. Richard, Frank J. Schwartz, and Marius S. Washbauer.

The usual order of business of the annual meeting was suspended to permit amendment of the constitution. Articles one through five of the constitution and articles one through eleven of the bylaws were amended. All votes were unanimous.

The officers and council members listed on page iii were elected by unanimous ballot. Victor G. Springer was introduced as the editor of the Proceedings, succeeding Richard H. Manville.

No formal communications were scheduled.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

ON VARIATION IN AN ANTHROPOCHOROUS SPECIES
OF THE ORIENTAL EARTHWORM GENUS
PHERETIMA KINBERG 1866¹

By

G. E. GATES

University of Maine, Orono

A very considerable mass of data *re* variation must be procured before "museum" or "typological" species in the classical system of the Oligochaeta can be considered good according to canons of the "New Systematics." The labors of Dr. Y. Kondo, his family and friends, as well as of herpetologist A. J. Loveridge (in his retirement), now have provided good series, from Hawaii and St. Helena respectively, of one species for comparison with lots from the United States, Mexico, Guatemala, Salvador, Bermuda, Brazil, Argentina, Madeira, South Africa, Pakistan, India, and Singapore.

The species herein considered is not too inappropriately named *hawayana* as it now appears, from Dr. Kondo's numerous collections of the last six years, to be the most widely distributed and common earthworm in Hawaii.

Pheretima hawayana (Rosa, 1891)

EXTERNAL CHARACTERISTICS

Size, of strongly contracted, unamputated specimens, 56-70 by 3-4 mm. (1 Hawaiian site), 110-156 by 5-6 mm. (another Hawaiian site), of relaxed specimens from Los Angeles and Singapore 165-200 by 6 mm. Segment number of individuals with a normal tail, *i.e.*, without regeneration or amputation, was 70-101 (*cf.* Table 1). The range is only slightly greater than that of previous records (*cf.* PR column, Table 1). However, Table 1 shows more than three-fourths of the specimens recently counted had 91-98 segments. Some of the tabulated specimens with fewer than 87 metameres may have been old posterior amputees without regeneration but with the present terminal region having been reorganized so as to look almost, if not exactly, like a normal

¹ From research financed by the National Science Foundation.

TABLE 1.—Segment number in *Pheretima hawayana* (Rosa, 1891)

| Number of segments | Number of specimens | | | | | | | | | | Totals |
|-----------------------|---------------------|------|-------------|----------------|--------|----|----|-----|----|----|--------|
| | PR | N.A. | Saint H. | Singa- pore | Hawaii | | | | | | |
| | | | | | A | B | C | D | E | F | |
| 70 | | | | | 2 | | | 1 | | | 3 |
| 71 | 1 | | | | 1 | | | 1 | | | 3 |
| 72 | | | | | | | | | | | |
| 73 | | | | | 3 | | 1 | | | | 4 |
| 74 | | | | | 1 | | | | | | 1 |
| 75 | | 1 | | | | 1 | | 1 | | | 3 |
| 76 | | | | | 1 | 1 | | 4 | | | 6 |
| 77 | | | 2 | | | 1 | | 3 | | | 6 |
| 78 | 1 | 1 | | 1 | | 2 | | 4 | 1 | 1 | 11 |
| 79 | | 1 | | 1 | | 1 | 1 | 6 | 1 | 1 | 12 |
| 80 | | | | | | 1 | | 4 | 1 | | 6 |
| 81 | | | 1 | 1 | | 1 | | 12 | | | 15 |
| 82 | | | | | | 1 | 1 | 8 | | | 10 |
| 83 | 1 | | | | | 1 | | 9 | 1 | 2 | 14 |
| 84 | | 1 | | | 1 | 1 | | 9 | 1 | | 13 |
| 85 | | 1 | | | | 1 | 1 | 4 | 1 | | 8 |
| 86 | 1 | | 1 | | | | | 3 | | 1 | 6 |
| 87 | | | 1 | 1 | 1 | | 1 | 3 | | | 7 |
| 88 | 2 | 1 | 1 | | | | | 10 | | | 14 |
| 89 | | 2 | 1 | 1 | | | 1 | 6 | | | 11 |
| 90 | 1 | 1 | 2 | | | | 1 | 11 | 5 | 4 | 25 |
| 91 | | 1 | 1 | | | | | 20 | 7 | 8 | 37 |
| 92 | 1 | 2 | 3 | | | | | 34 | 6 | 5 | 51 |
| 93 | 1 | 6 | 8 | 2 | | | 4 | 58 | 7 | 12 | 98 |
| 94 | 1 | 3 | 9 | 4 | | | 2 | 59 | 11 | 12 | 101 |
| 95 | 1 | 2 | 7 | 4 | | | 4 | 57 | 8 | 11 | 94 |
| 96 | 1 | 1 | 6 | 5 | | | 1 | 47 | 4 | 5 | 70 |
| 97 | 1 | 1 | 4 | 1 | | | 1 | 22 | 1 | 1 | 32 |
| 98 | | | 1 | 1 | | | 2 | 15 | 1 | | 20 |
| 99 | | | | 1 | | | | 7 | 2 | | 10 |
| 100 | | | | | | | | | | | |
| 101 | | | | | | | | 1 | | | 1 |
| Totals | 13 | 25 | 48 | 23 | 10 | 12 | 21 | 419 | 58 | 63 | 692 |

PR Previous records. Information as to number of counts rarely was published. Records such as 71-94 and 88-95 accordingly are tabulated above as 71 once, 94 once, 88 once, 95 once.

N.A. North America.

Saint H. Saint Helena.

adult tail. Usually the last 2-6 segments of unamputated individuals are quite small, with few or no visible setae but with the color of the more anterior metameres.

Color, various, brownish, reddish brown, yellowish brown, reddish, almost purple, slate, greyish, bright red (almost only in young juveniles). Total albinism was not seen but an Indian series from 5,500-6,000 feet, at Gangtok, Sikkim, contained one individual in which pigmentation gradually disappeared in the region of xvii-xxviii. From xxix posteriorly the soma was of an unusually clear white. Iridescence occasionally is marked and of a brilliant green but is especially obvious on worms with cuticle more or less loosened. Prostomium, epilobous, tongue open (354 specimens). Setal size increases from ii through vi, especially ventrally, as the distance between follicle apertures increases. Size is much smaller in vii though somewhat larger, at least ventrally, than in viii and posteriorly where intersetal distances are smaller. Setal counts on a St. Helena worm of 91 segments were as follows; 20/ii, 20/iii, 40/viii, 40/xii, 53/xx, 50/xxx, 51/xl, 49/l, 59/lx, 56/lxx, 47/lxxix, 45/lxxx, 49/lxxxi. Previous records, 40 in spermathecal segments, 60-64 in postclitellar segments (Hawaii), 56/xii (Yunnan), 17-21/iii, 36-40/viii, 44-49/xii, 48-56/xx (Burma). Determining limits of variation in number per segment is complicated by the absence of information about shedding (which is involved) as well as about any correlation of number with soma size. Number per segment seems to increase gradually to somewhere in the region of xii-xxv and then near the hindend gradually decreases. Setae almost always were recognizable in xvi of St. Helena and Hawaii worms. The number, 3 (1 specimen), 4 (3, including 1 Mexican), 6 (4), 7 (3), 8 (5), 9 (8), 10 (8), 11 (4), 12 (6), 13 (5), 14 (5), 15 (1), 16 (5), 17 (6), 18 (6), 19 (2), 28 (1, with but slight modification of clitellar epidermis), 30 (1), complete ring (1). Some of those larger numbers might have become smaller by the time clitellar tumescence was maximal. Setae were recognized in xiv more often than in xv but occasionally were present in both. Whether setae are retained in follicles of clitellar segments after occlusion of the follicle apertures is unknown. Number of setae between male porophores in xviii, 11 (2 specimens), 13 (5), 14 (6), 15 (11), 16 (9), 17 (3), 18 (5), 19 (2), 21 (1), previously recorded 10-15 (Burma).

First dorsal pore, function determined by bending the worm slightly toward ventral side so as to force fluid out of coelomic cavity, usually

←

- A Probably old or obviously recent amputees.
- B Possibly amputees?
- C Very small unamputated juveniles from a locality at which only *hawayana* was obtained.
- D Others, including late juvenile, aclitellate and clitellate individuals presumably unamputated and without regeneration.
- E Juvenile, 1964, only those with tail regenerates screened out.
- F Mature, 1964, only those with tail regenerates screened out. The 1964 series were from several islands.

TABLE 2.—Location of first dorsal pore in *P. hawayana*

| Intersegmental furrows | Number of specimens from | | |
|------------------------|--------------------------|-----------|--------|
| | Saint Helena | Singapore | Hawaii |
| 9/10 | | | 2 |
| (9/10?) 10/11 | | | 20 |
| 10/11 | 27 | 22 | 359 |
| (10/11?) 11/12 | 1 | | 16 |
| (9/10, 10/11?) 11/12 | | | 3 |
| 11/12 | 1 | | 4 |
| (10/11, 11/12?) 12/13 | | | 1 |

at 10/11. Pore-like spots from which no fluid emerged are indicated in Table 2 by question marks. As in case of the prostomium and other structures, characters were not recorded for every specimen, especially after lack of significant variation became obvious.

The clitellum never seemed to extend all the way through the usual three segments but is much more likely to reach 13/14 than 16/17. Nevertheless, the dorsal pore at 13/14 always seemed to be functional as did the pore at 16/17. Intersegmental furrows 14/15, 15/16 are obliterated and the dorsal pores at those two levels are occluded. Earliest regular dehiscence of setae during growth appears to be near mV in xiv.

Spermathecal pores often are quite unrecognizable in strongly contracted and well-preserved material. Variation in number of spermathecae, accordingly may be greater than was determined from the dissections. The pores, always minute and superficial, always are median to mL and perhaps are usually about 1/3 C apart. The female pore always was minute and superficial and probably is uniformly so through the genus, the family Megascolecidae and other megadrile families with the single exception of the Eudrilidae. A single pore, in xiv of *hawayana*, always was median. A pair of female pores, in xiv, was present on two worms, one each from Mexico and Hawaii. Male pores also always were minute and superficial but usually were closed (like the female pore), and in that condition sites were not certainly distinguishable. Male porophores usually were somewhat larger than adjacent genital markings but on several Singapore specimens were almost exactly of the same size. Anlage of the male porophores become recognizable during growth before those of the genital markings.

Genital markings are rather small, circular areas, distinctly delimited peripherally and often with a discoidal appearance. A slightly raised marginal band is opaque and a slightly concave central area of contracted worms is greyish translucent. Such a central area was lacking on relaxed specimens. Instead there was recognizable, just inside the marginal band, a circle of 8–12 greyish translucent dots, each of which may show site of a pore of one unit of the composite gland that is associated with

TABLE 3.—Number and location of preclitellar genital markings in *Pheretima hawayana*

| Segments | Number of specimens from | | | | | Totals |
|----------|--------------------------|------------------|---------------|-----------|--------|--------|
| | Burma PR | North America | St. Helena | Singapore | Hawaii | |
| v-vii | | 1 | | | | 1 |
| vi-vii | | | | | 2 | 2 |
| vii | 4 | 7 | 4 | 10 | 169 | 194 |
| vii-viii | 2 | | | | 11 | 13 |
| viii | 6 | | 1 | 3 | 9 | 19 |

each marking. With one exception (a St. Helena worm with a pair of markings in xvii) postclitellar markings were confined to xviii. All markings were postsetal. Markings were absent in 10 specimens including 4 from St. Helena and 6 from Hawaii. Preclitellar markings are median to longitudinal meridians of the spermathecal pores by distances equal to 2-4 nearby intersetal intervals and are closer to the intersegmental furrows (posterior) than to the segmental equators. Postclitellar markings of xviii always are in a region just posteromedian to the male porophore. As many as nine postclitellar markings were previously reported from Bermuda, 10 from Burma, 12 from Honolulu as well as from a Kurseong site in the Himalayas but more than 12 of the tubercles only now are recorded and from Hawaii alone. The larger numbers are not as yet regarded as peculiar to Hawaii for only from those islands were enough specimens examined to reveal the probable range of variation, 0-21. Markings are in one or more transverse rows of two to six but the row arrangement is less obvious when numbers are larger. Positioning often is the same on both sides of xviii even when the numbers are different. Determining just which markings of one side are lacking on the other, often is possible.

INTERNAL ANATOMY

Pigment, always reddish brown and in the circular muscle layer, often present in the special longitudinal band at mD, was dense in the preclitellar dorsum and more sparse posteriorly. The longitudinal muscle band at mD ends anteriorly in x. Brain and commissures were left in iii by a transverse section exactly along 3/4 if the buccal cavity was completely retracted. That cavity can be everted until the protrusion is longer than combined lengths of i-ii. When so everted the brain usually was left in ii, but posteriorly, by a transverse section exactly along 2/3. The brain was however left in iii anteriorly or posteriorly of two worms with marked buccal protrusion.

Variation in thickness of certain anterior septa is difficult to estimate and the more obvious differences seem to be associated with contracted-relaxed states of the soma. Septa 5/6-7/8, 10/11-13/14, certainly are

TABLE 4.—Number of postclitellar markings in *P. hawayana*

| Number of markings on left and right sides | Number of specimens from | | | | | Totals |
|--|--------------------------|---------------|--------------|-----------|--------|--------|
| | Burma PR | North America | Saint Helena | Singapore | Hawaii | |
| 0-0 | | | 4 | | 6 | 10 |
| 0-1 | 5 | | 1 | 2 | 4 | 12 |
| 1-0 | | | | | 5 | 5 |
| 0-2 | | | 1 | | 1 | 2 |
| 2-0 | | | | | 2 | 2 |
| 0-3 | | | | | 1 | 1 |
| 3-0 | | | | | 1 | 1 |
| 5-0 | | | | | 1 | 1 |
| 1-1 | | 13 | 8 | 16 | 28 | 65 |
| 1-2 | 3 | 2 | 8 | | 23 | 36 |
| 2-1 | 1 | | 9 | 5 | 14 | 29 |
| 1-3 | | | | | 4 | 4 |
| 3-1 | | | | | 4 | 4 |
| 4-1 | | | | | 1 | 1 |
| 2-2 | 9 | 9 | 8 | 8 | 98 | 132 |
| 2-3 | 2 | | 4 | | 28 | 34 |
| 3-2 | | | 1 | | 26 | 27 |
| 2-4 | | | | | 8 | 8 |
| 4-2 | | | | | 3 | 3 |
| 6-2 | | | | | 1 | 1 |
| 3-3 | | | 5 | 1 | 54 | 60 |
| 3-4 | 1 | 1 | | | 24 | 26 |
| 4-3 | | | 2 | | 18 | 20 |

thickened and opaque, probably with some gradual decrease posteriorly through the last four. Septum 9/10 always was aborted except perhaps for some ventral rudiment in the wall of the anterior testis sac. Septum 8/9 usually appeared to be aborted except for occasional persistence of a ventral rudiment, but in one specimen was complete though transparent. Such a delicate membrane can be ruptured so as to leave only a ventral rudiment merely by pinning back the body wall to permit examination of internal organization. As in all other pheretimas, when 8/9 is present the gizzard was confined to viii.

No variation of importance was noticed in characters of gizzard, esophagus. The intestinal origin always was in xv but sometimes the portion in xv had been drawn back into the interior of the gut in xvi so as to produce an appearance of the intestine beginning in xvi. When so withdrawn, determination of the origin can be difficult or even impossible if preservation is poor. An intestinal caecum was lacking in a single worm but in several others one of the caeca at first inspection appeared to be absent because it had been completely withdrawn into the interior of the gut. Recognition of the withdrawal could be very

TABLE 4.—*Continued*

| Number of markings on left and right sides | Number of specimens from | | | | | Totals |
|--|--------------------------|---------------|--------------|-----------|--------|--------|
| | Burma PR | North America | Saint Helena | Singapore | Hawaii | |
| 3-5 | | 1 | | | 4 | 5 |
| 5-3 | | | | | 6 | 6 |
| 3-6 | | | | | 3 | 3 |
| 3-7 | | | | | 1 | 1 |
| 4-4 | | | 4 | | 38 | 42 |
| 4-5 | | | | | 14 | 14 |
| 5-4 | | | | | 16 | 16 |
| 4-6 | 1 | | | | 1 | 2 |
| 4-7 | | | | | 1 | 1 |
| 5-5 | | 1 | | | 28 | 29 |
| 5-6 | | | | | 5 | 5 |
| 6-5 | | | | | 9 | 9 |
| 5-7 | | | | | 2 | 2 |
| 7-5 | | | | | 2 | 2 |
| 6-6 | | | | | 12 | 12 |
| 6-7 | | | | | 3 | 3 |
| 7-6 | | | | | 3 | 3 |
| 8-6 | | | | | 3 | 3 |
| 7-8 | | | | | 1 | 1 |
| 8-7 | | | | | 2 | 2 |
| 8-10 | | | | | 2 | 2 |
| 9-10 | | | | | 1 | 1 |
| 10-9 | | | | | 2 | 2 |
| 11-10 | | | | | 1 | 1 |

difficult if preservation is poor as it often is in an anterior portion of the intestinal region. An intestinal typhlosole is lacking or rudimentary and then somewhat widened but interrupted and with smaller diagonal ridges in a few segments (*cf.* Table 6) behind which no further trace is distinguishable.

Variation in the circulatory system at first appeared to be rampant and even to involve all major trunks. No trace, for instance, of a subneural trunk was recognizable in one specimen. A subneural with a pair of branches in each segment was obvious in another worm, in front of lxi, but in many individuals no vestige of the trunk was visible in front of xiii or xiv. Those and many other seeming variations are now believed to be due to the volume of blood being much smaller than that of the spaces through which it has to flow. Vessels, especially those with thin and transparent walls presumably collapse when empty and then are indistinguishable from adjacent tissues. Adding together conditions observed in various specimens enables an assumption that the subneural

TABLE 5.—Variation in number of postclitellar genital markings in *P. hawayana*

| Number of markings | Number of specimens |
|--------------------|---------------------|
| 0 | 10 |
| 1 | 17 |
| 2 | 68 |
| 3 | 66 |
| 4 | 140 |
| 5 | 63 |
| 6 | 71 |
| 7 | 46 |
| 8 | 56 |
| 9 | 33 |
| 10 | 30 |
| 11 | 15 |
| 12 | 16 |
| 13 | 6 |
| 14 | 3 |
| 15 | 3 |
| 18 | 2 |
| 19 | 3 |
| 21 | 1 |

TABLE 6.—Widening of the typhlosole in *P. hawayana*

| In segments | Number of segments in the worm |
|-------------|--------------------------------|
| 41-52 | 94 |
| 43-56 | 79 |
| 45-56 | 81 |
| 46-54 | 78 |
| 46-63 | 94 |
| 47-64 | 99 |
| 48-60 | 89 |
| 50-59 | 87 |
| 50-61 | 94 |
| 50-64 | 94 |
| 52-64 | 98 |
| 52-65 | 97 |
| 53-63 | 95, 96 |
| 56-66 | 96 |

TABLE 7.—Location of the hearts of ix in *P. hawayana*

| Sides | Number of specimens from | | | |
|----------------|--------------------------|-----------|------------|--------|
| | North America | Singapore | St. Helena | Hawaii |
| Left and right | 2 | | | 3 |
| Left only | 7 | 8 | 1 | 57 |
| Right only | 9 | 9 | | 74 |

really is complete from one end of the body to the other though a blood-filled condition was not seen in any single individual. The trunk always was adherent to the parietes and the anterior bifurcation was under or just in front of the subpharyngeal ganglion. The dorsal trunk usually is distended with blood and obvious throughout most of the major axis but its wall becomes thinner in front of 6/7 with the result that anterior bifurcations and connections with the ventral trunk usually are unrecognizable. Hearts of xi–xiii are believed to be always lateroesophageal though blood in the slender connectives to the dorsal trunk usually was lacking. Hearts of x, presumably esophageal as no tissue passing to the dorsal trunk was seen, were recognized because distended with blood, in 63 specimens. In others a blood-filled heart was found on one side. A distended heart without blood was recognized on several occasions. Whether hearts of x were merely unrecognizable because empty or were lacking in 25 specimens is unknown. One or the other of the always lateral hearts belonging to ix usually had aborted (*cf.* Table 8) and a similar abortion could have eliminated one or both hearts of x. Major portions of the hearts of viii always had aborted, the remaining short portions passing from the dorsal trunk to the gizzard. Hearts of vi–vii, when complete always were lateral but frequently, and most often in vi, could not be traced to the ventral trunk. Extra-esophageal trunks occasionally were seen to pass off from gut to parietes and then to run straight posteriorly into xiv and further back before turning to the subneural. Occasionally a pair of connectives, posteriorly in xiii, between supra-esophageal and subneural were recognized. Lymph glands, in especially well-preserved specimens were present from xvi posteriorly. Blood glands, believed by Stephenson (1924) to be vestigial in this species, were not always distinguishable in each of iv–vi.

Testis sacs, always ventral, usually were unpaired and often were above the nerve cord (but this character frequently was not recorded). Some of those that appeared at first glance to be paired actually were unpaired. Communication between sacs of different segments always was lacking. Seminal vesicles of juveniles always had a demarcated dorsal lobe (primary ampulla) that often was not recognized in adults. At maturity, vesicles always were soft and fairly large, usually filling all available space in coelomic cavities of xi and xii. Pseudovesicles of xiii and xiv, in juveniles so small that spermathecae had not become visible in coelomic cavities, were larger relative to soma size than in

TABLE 8.—Variation in number of normal spermathecae in *P. hawayana*

| Locations of extra sperma- thecae | Number of specimens from | | |
|---|--------------------------|------------|--------|
| | Burma PR | St. Helena | Hawaii |
| Left side of v | 1 | | |
| Left and right sides of v | 1 | | |
| Left side of ix | | 1 | 3 |
| Right side of ix | 4 | | 1 |
| Left and right sides of ix | 2 | 1 | 2 |
| Left and right sides of v, right side of ix | 1 | | |
| Right side of ix (but left anterior spermatheca lacking) | 1 | | |

adults though slightly smaller than the vesicles of xi, xii. A small clump of granular brown debris occasionally was present dorsally in adults. These anomalous organs are serially homologous with the seminal vesicles of xi-xii but no one ever suggested that they were once associated, even in a very ancient past, with testes in xii and xiii. The vesicles in xiv, at various times, were said to be ovisacs but ova never were found therein. Prostates always were present and those of adults (extending through some or all of xvi-xxiv) always were in a mature and presumably functional state though what that function may be is unknown. Prostatic ducts were 3-6 mm. long, always muscular, in a hairpin bend, variously twisted or looped. Vasa deferentia always passed into the gland near the prostatic duct or into the ental end of the duct.

Ovaries always were more or less fan-shaped and at full maturity with numerous egg strings. Spermathecae were fairly large, when the ampulla was distended reaching up into contact with the dorsal parietes and filling most of the coelomic cavity in their own segments. The single diverticulum, from anterior face of duct at the parietes, always was shorter than the main axis and very rarely was shorter than the duct. A seminal chamber usually was not distinctly demarcated but is represented by an asymmetrical and gradual widening of a considerable ental portion of the diverticulum. Even when a terminal ental portion was constricted so as to have a size and shape of the *diffrigens* seminal chamber, sperm were not confined therein but were continued much further ectally as usual. Slenderness of the spermathecal duct is characteristic. Extra spermathecae were present in 10 of 465 Burmese specimens. Recognized variation in number of normal spermathecae, with two exceptions, are indicated in Table 9. Omitted individuals (2) lacked one organ, the right posterior spermatheca (Polynesia), the left anterior spermatheca (Hawaii).

Each spermatheca (whether extra or otherwise), in every specimen dissected, opened anteriorly. Sperm usually were present in seminal

chambers of extra spermathecae and white coagulum usually was present in the ampullae.

GM glands are stalked and coelomic. One such gland usually was associated with each preclitellar genital marking. Occasionally, when a genital marking was rather indistinct, glandular material seemed to be lacking at ental ends of the stalks. A gland that passes into the parietes with the spermathecal duct sometimes has been mistaken by certain authors for a spermathecal diverticulum but in each such case found in *hawayana* the stalk could be traced to a discrete marking. The gland probably is composite as the stalk seems to be so. Behind the clitellum exact correspondence between glands and markings was lacking. One worm with 3-5 glands in xviii had only 1-1 markings. Gland/GM ratio of two other worms were 2-2/1-1, 3-3/2-2. Some of the extra glands may pass to the male porophores as seems to be the case in *P. diffringens*, but in several specimens without postclitellar markings no glands were present in xviii. Glands may sometimes appear at first to be absent because bound down against the parietes.

ABNORMAL SPECIMENS

No. 1. Left spermatheca of vi adiverticulate (Burma PR).

No. 2. An adiverticulate spermatheca on right side of ix (Burma PR).

No. 3. An adiverticulate spermatheca on left side of v (Burma PR).

No. 4. Adiverticulate spermathecae on left side of v and right sides of v and ix (Burma PR).

No. 5. Ental half of diverticulum of right posterior spermatheca, bifid. Left posterior spermatheca doubled, including pores. All seminal chambers with sperm (Hawaii).

No. 6. Two pairs of spermathecae in vi. Three spermathecae on right side of vii, the medianmost adiverticulate. Two spermathecae on left side of vii, right side of viii. Two adiverticulate spermathecae on left side of viii. Spermathecal pores were not recognized but each duct passes into and through the muscular layers independently. Except as otherwise indicated each spermatheca is normal and with spermatozoal iridescence in the diverticulum (St. Helena).

No. 7. Right posterior spermatheca, with sperm in a normal diverticulum. Main axis (ental to parietes which is about of normal duct length has no indications of differentiation into duct and ampulla (Hawaii).

No. 8. The extra diverticulum of a bidiverticulate spermatheca is short but does have sperm in a spheroidal seminal chamber.

No. 9. An extra male porophore, on left side of xvii, with its own prostate. Left sperm ducts pass into anterior prostatic duct (St. Helena). The condition could have resulted from elision of a mesoblastic somite at the 16th or 17th level associated with halving of the somite at the 18th level. (Location of intestinal caeca unknown.)

No. 10. Heart of xiii, lacking.

No. 11. Seminal vesicles, lacking (St. Helena). Male funnels, without any trace of iridescence. Iridescence in spermathecae showed that copulation had been completed. The worm was male sterile and its copulatory partner clearly could have received no foreign sperm! Whether that partner could have received any of its own seems doubtful and, if not, absence of spermatozoa in the spermathecae is not always an indication that copulation had not taken place.

No. 12. Median female pores, in xiv, xv. Left male pore, in xix. Clitellum, of left side in xv-xvii. Paired pseudovesicles of xiii, xiv unusually large. A heart present in xiv on left side. Ovaries on left side, in xiii, xiv, each with a female funnel and oviduct. Intestinal origin of left side slightly more posterior than on the right side but both intestinal caeca appear to arise in xxvii. Abnormal conditions obviously arose from halving of the left mesoblastic somite at the 13th level. However, the left intestinal caecum presumably should be one segment behind the right. (Except as otherwise indicated, the specimen was normal. Hawaii.)

Presence of a pair of normal spermathecae in ix certainly represents a reversion to a more or less distant ancestral stage and suggests derivation of *hawayana* from an octothecal form with spermathecal pores at 5/6-8/9.

Presence of a pair of normal spermathecae in v with or without a pair in ix can be regarded in a sense as prophetic as well as indicative of ways that octothecal species with pores at 4/5-7/8 and decathecal species with pores at 4/5-8/9 may have arisen. Evolution accordingly may proceed not only by addition of a pair of organs at one or the other end of a series but also by simultaneous addition of a pair at each end. In that latter way a decathecal battery presumably could have arisen in *Pheretima* only after a previous deletion of an extremely ancient pair in ix.

Metameric abnormality. In the first 20 segments the only anomalies found were spirals: involving ii-iii (1 specimen), iv-vii (1), xvii-xix (1). Anomalies, of the usual kinds, in the region behind xx were recorded but only during segment counting and only on the side on which the count was made. Too many would have been overlooked to warrant discussion of frequency.

REGENERATION

Cephalic. No. 1. Amputation of or damage to the anterior end, left this worm with a peristomium much longer than usual. Ventrally there were several setae perhaps retained from the original second segment, though no vestige of an intersegmental furrow was recognized anywhere in the peristomium. If that buccal region is considered to be i, all organs are one segment in front of their normal location.

No. 2. A head regenerate of four normal segments, at 4/5.

No. 3. After anterior amputation at 13/14 an imperforate cicatrix was formed without regeneration.

TABLE 9.—Number of segments in tail regenerates of *P. hawayana*

| Level of regeneration | Number of segments in regenerate |
|-----------------------|----------------------------------|
| 49/50 | 14 PR |
| 51/52 | 11 |
| 52/53 | 12, 20 |
| 53/54 | 17 |
| 55/56 | 17, 10, 10 |
| 58/59 | 19, 22 |
| 59/60 | 13, 17 |
| 61/62 | 21 |
| 62/63 | 17 |
| 63/64 | 9 PR |
| 64/65 | 11 |
| 68/69 | 6(#), 7 |
| 67/68 | 12 |
| 71/72 | 5 |
| 73/74 | 4 |
| 74/75 | 2 |
| 75/76 | 8 |
| 76/77 | 4-6(?) |
| 78/79 | 5, 6, 7 |
| 79/80 | 5 |
| 82/83 | 3 |
| 84/85 | 3, 5, 5 |
| 85/86 | 4 |
| 89/90 | 5 |

(#) Metameric abnormality in the regenerate.

(?) Metameric abnormalities.

PR Previous record. The regenerate at 49/50 with metamerism anomalies proximally.

No. 4. After anterior amputation at an unknown level behind 18/19 an imperforate cicatrix was formed without regeneration.

Caudal. Metamerically segmented tail regenerates were found at various levels from 51/52 posteriorly. The data in Tables 10 and 1 suggest that tail regeneration is hypomeric regardless of level but that number of segments does decrease as level of amputation moves posteriorly. The hypomery is much less near the hindend.

Metamerically undifferentiated tail regenerates were present, one each, at 39/40, 45/46, 51/52, 52/53, 80/81, 83/84, 85/86. Some, including one at 51/52, seemed likely to become pygomeres with demarcation from substrate by an intersegmental furrow. Others, including one at 85/86, were somewhat larger and looked as if further development might have allowed some metamerism differentiation. A regenerate of 16 segments may have been present at 57/58 as behind that level segments

abruptly became much smaller. However, no difference in pigmentation was recognized behind 57/58. The last five segments of six worms probably were regenerated but are excluded as difference of pigmentation from substrate could not have been recognized because of alcoholic preservation.

Reorganization, in the case of regeneration at 85/86, had resulted in the last substrate segment becoming much narrower and darker but no shorter. Almost all of the setae had been lost.

After posterior amputation at 39/40 and at 40/41, two worms (Gangtok) had formed an imperforate cicatrix without regeneration. Seven of 70 Gangtok adults were unregenerate posterior amputees.

The last two to six segments of most unamputated and mature worms, it should be here emphasized, are quite small, with few or no setae visible and except for presence of pigment looking somewhat like tail regenerates.

REPRODUCTION

Male funnels and spermathecal seminal chambers of clitellate individuals usually were iridescent. As sperm are exchanged during copulation, reproduction is assumed to be biparental. Further support for such an assumption is provided by the rarity, in 1,000+ specimens, of those organ deletions that are so characteristic of megadrile parthenogenesis. Moreover, presence of sperm on male funnels and in spermathecae was so general, in the many specimens studied, that option of parthenogenesis seems unlikely. Condition of seminal vesicles and of the prostates at maturity, except for one individual, was compatible with biparental reproduction. Finally, abnormalities that were encountered were mostly of sorts less likely to characterize uniparental polymorphism.

Spermathecal ampullae of sexual worms are distended by a material that is white and flocculent. Ampullae of postsexual individuals contain, after preservation, a transparent jelly (pinkish or colorless) or a watery fluid or are empty, presumably showing different stages in lysis and absorption of the material of unknown function.

Sperm were present on male funnels and in spermathecae of a Singapore worm that had no trace of a clitellum. Spermathecal ampullae were empty but their content may have been absorbed during regeneration of an 11-segment tail regenerate at 64/65. Iridescence of spermathecal seminal chambers and distention of spermathecal ampullae by the white material was noted in specimens (from North America, Hawaii, St. Helena, and Singapore) that had been recorded from external inspection as late juvenile or early adult. Those specimens showed no indication of postsexual regression such as shrunken seminal vesicles or presence of brown debris in the vesicles. On the contrary, intersegmental furrows 14/15–15/16 were obvious or rather faint (an early stage of obliteration?), setal circles of xiv–xvi were uninterrupted and dorsal pores at 14/15 and 15/16 still were functional. Cuts through the body wall of xiv–xvi revealed no macroscopically recognizable epidermal

tumescence. Seminal vesicles as well as testis sacs were distended and without brown debris.

Unless individuals of *hawayana* are able to eliminate all other evidence of previous sexuality except the spermatozoal iridescence on their male funnels and in their seminal chambers, maturation and exchange of sperm do take place prior to appearance of the clitellum.

Conditions also indicative of preclitellate copulation, have been seen in other species of *Pheretima* as well as in individuals of other genera and families. Stigmata of postsexual regression still were recognizable in worms of various species examined soon after emergence from a rest period. No evidence has been found in the literature to indicate that megadriles can eliminate all traces of previous sexuality during a period of reproductive inactivity.

Nevertheless, all copulating earthworms seen by the author were clitellate and reports of all special studies of megadrile copulation record the participating individuals as clitellate.

PARASITES

An isolated cyst here and there, sometimes only one, was present in the nerve cord of a very few specimens. Cysts were numerous enough in three worms to interrupt neural continuity at one or more levels though no indication of that condition was recognizable externally. A few individuals had parietal cysts. Coelomic nematodes were not found. No search was made for macroscopically unrecognizable organisms—inhabitants of the seminal vesicles (at least) already had been studied at several localities and still are under investigation elsewhere. Information regarding the cyst-producing organisms may eventually be published by some of those to whom material has been sent.

Most of the individuals that were dissected either had not been exposed to the massive infestations so common in other taxa—and more particularly in parthenogenetic morphs of certain pheretimas—or else had been much more resistant.

DISCUSSION

A thousand and more specimens of *P. hawayana* were examined by the author. Each individual that showed, in the first 20 segments, any externally recognizable indication of interesting conditions, was dissected. Internal anatomy of additional samples from each lot that became available also was studied. Characters, such as location of the first dorsal pore and of the genital markings, were determined for every individual of small lots and from random samples (varying in size) of longer series. Divergence or variation from normal in the anatomy was noted in laboratory records without numbering normal specimens or conditions that were seen. Normal or usual seemed to be the same everywhere. Deviation from normal or usual, whenever material was sufficient to permit judgment, always seemed to be similar. *P. hawayana* is exotic in the regions from which all of the material was obtained. Comparison

with worms from the original home of the species, believed to be somewhere in China, has been impossible. Nothing is known about the variation of *hawayana* in its presumed native place.

Significant variation, with respect to some of the most important characters by which pheretimas have been keyed and defined, was found in a number of specimens with no probability of parthenogenesis being involved. Whether any species actually were erected on such variant specimens remains to be learned.

Most species of megadrile oligochaetes are "typological" or "museum" taxa. Some must remain in that condition until such time as arrangements can be made somewhere in the world for extended systematic research on a long-neglected group. Less excusable is the state of our knowledge about many common and widely distributed species. What those zoologists, primarily interested in identifications, did, with the many specimens they must have had that diverged in major ways from the type or that differed significantly from the original description, probably will remain unknown. The wastebasket answer, so often suggested by the skeptic, does precisely state the fate of admittedly unidentified material. Of greater importance may have been the divergent or aberrant individuals that were identified, perhaps erroneously, without characterization, comment, or explanation.

Attention already has been called (Gates, 1960, p. 278) to the importance for megadrile systematics of anomalous, aberrant (including those that may be induced by or result from parasitism and parthenogenesis) and regenerative variations.

LITERATURE CITED

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NEW SPECIES OF DELTOCEPHALINAE
FROM THE AMERICAS
(HOMOPTERA: CICADELLIDAE)

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The purpose of this paper is to describe fourteen new deltocephaline leafhoppers from the Americas. With three exceptions, all of the species represent genera which have been comparatively recently revised. I use *Deltocephalus* Burmeister for six new species which occur south of the United States in the same sense as Linnavuori (1959: 98-119) used *Amplicephalus* DeLong. A complete re-evaluation of both *Deltocephalus* and *Amplicephalus* is the subject of a study in progress. The five new species of *Graminella* DeLong described herein can be related to the Nearctic fauna by reference to DeLong and Mohr (1937) and to the Neotropical fauna by reference to Linnavuori (1959: 119-125). Oman (1949: 174-175) lists thirty species for the genus *Polyamia* DeLong; I have studied all of them and take this opportunity to add two new ones. The one new genus, *Quaziptus*, described herein is really not very close to any other genus known to me.

I have intentionally omitted many comparative notes and statements such as "keys to . . . , but differs by . . . " in the belief that they would be of little value. In most groups of the leafhoppers, and particularly in the Deltocephalinae, positive specific determinations can be made only by reference to the male genitalia. The male genitalia of all the species described here are illustrated, so recognition of species should present no problems. All of the specimens mentioned in this paper are in the collection of the United States National Museum.

***Deltocephalus metcalfi*, new species**

(Figs. 1-4)

Length: 3.0 mm.*Structure:* Crown in dorsal view rather sharply angular, median length one and a fourth times as long as narrowest width between eyes. Forewing with apical cells short, central preapical cell usually undivided, at times with a few extra irregular crossveins in some of the preapical cells.*Coloration:* Venter, legs, and face as in *D. buysi* n. sp. Crown sordid stramineous with a pair of small elongate dark brown spots at apex and a pair of large, round, dark brown to black spots, one of which occurs behind each ocellus, on anterior portion of disc. Pronotum sordid stramineous to light brown with or without five paler, weakly defined, longitudinal stripes. Scutellum light brown, variably touched with dark brown. Forewings light brown hyaline, veins pale stramineous, with cells lightly and variably infuscated.*Male Genitalia:* Aedeagus in lateral view quite uniform in stoutness except at slightly recurved apex which has a small but distinct dorsal notch and a sharp ventral extension (Fig. 1). Gonopore at base of ventral extension (Fig. 2). Aedeagus in ventral view rounded basally and tapered toward apex (Fig. 3). Distal portion of style with mesal lobe long, stout, and excavated on mesal two-thirds (Fig. 4).*Female Genitalia:* Female unknown.*Types:* Holotype (USNM Type No. 67196) and two paratype males, Cuaro., Michoacán, Mexico, 31 August 1938, L. J. Lipovsky. I was not able to locate "Cuaro." in Michoacán. There are four localities between Guadalajara and Morelia on or near Mexican Highway 15 which have this word as part of their name; these are: Lake Camedcuaro, Tangancicuaro, Capacuaro, and Pátzcuaro.*Remarks:* The coloration and markings of *metcalfi* are similar to several species of *Graminella*, but the closed inner preapical cell places the species in *Deltocephalus*. The male genitalia, particularly the aedeagus, are highly distinctive. The species is named for the late Dr. Z. P. Metcalf whose monumental catalogues are known to all workers in the Homoptera.***Deltocephalus youngi*, new species**

(Figs. 5-8)

Length: 3.5-4.0 mm.*Structure:* Crown in dorsal view rather bluntly angular, median length about one-fifth shorter than narrowest width between eyes. Forewing with central preapical cell divided by a cross vein.*Coloration:* Venter and legs stramineous to pale brown and immaculate to lightly touched with darker shades. Face with ground color light brown, only clypellus and clypeus marked with dark brown which appears grossly as a dark, irregular, longitudinal band on midline of face. Crown pale brown to stramineous with three pairs of small dark

anterior marginal spots, the outermost spot on either side occurs behind an ocellus. Pronotum pale brown with five more or less distinct paler, narrow, longitudinal stripes. Scutellum pale brown without definite markings. Forewings light brown hyaline, veins sordid whitish, with cells lightly infuscated at margins.

Male Genitalia: Aedeagus in lateral view stout basally but abruptly narrowed in distal half, shaft serrated dorsally and preapically, and terminating with an arrowhead-like apex (Fig. 5). Gonopore dorsal at slightly notched apex (Fig. 6). Aedeagus in ventral view rounded basally with shaft expanded preapically (Fig. 8). Distal portion of style with mesal lobe bent laterally, rugose and enlarged apically (Fig. 7).

Female Genitalia: Posterior margin of pregenital sternum indented mesally with a large blunt tooth at center.

Types: Holotype (USNM Type No. 67199) male, allotype female, and two paratype females, Depto. Escuintla, Guatemala, 500–1,000 ft, 5 April 1950, light trap, J. M. Brennan.

Remarks: The darkly colored central portion of the face will distinguish *youngi* from all other Neotropical species in the genus except *pallus* n. sp. The unique aedeagus and styles will separate *youngi* from all other members of *Deltocephalus*. The species is named for Dr. D. A. Young who is one of the world's foremost authorities on leafhopper classification.

***Deltocephalus buysi*, new species**

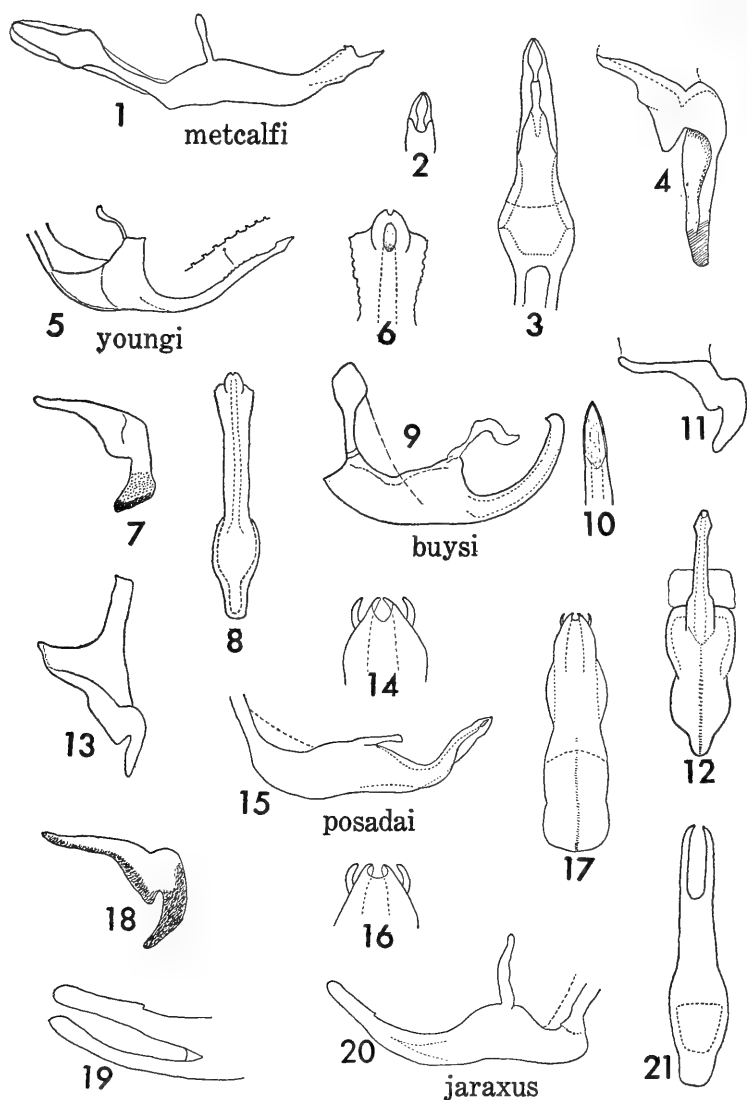
(Figs. 9–12)

Length: 3.5 mm.

Structure: Crown in dorsal view rather bluntly angular, median length two fifths shorter than narrowest width between eyes. Forewing with central preapical cell divided by a crossvein.

Coloration: Venter and legs basically light brown but variably marked with darker areas. Face with ground color light brown to sordid stramineous, heavily marked with dark brown especially on sutures. Usual dark clypeal arcs present. Crown light brown, anterior margin paler with a pair of small dark brown apical spots and a pair of narrow crescentic spots, one of which occurs behind each ocellus. Pronotum light brown with five more or less distinct pale, narrow, longitudinal stripes. Scutellum light brown without distinct markings. Forewings light brown hyaline with veins pale, very sparse infuscation at margins of some cells.

Male Genitalia: Aedeagus in lateral view moderately elongated, stout basally with distinct heel, sharply narrowed, and gradually upturned distally with a small proximal beak at apex (Fig. 9). Gonopore ventral at unnotched apex (Fig. 10). Aedeagus in ventral view with distinct heel, mesal indentations in basal portion, and a sharp narrowing of distal portion (Fig. 12). Connective exceedingly short (Fig. 9). Distal portion of style undistinguished (Fig. 11).



Figs. 1-21.—*Deltocephalus metcalfi*, n. sp.: 1, aedeagus and connective laterally; 2, aedeagal apex dorsally; 3, aedeagus ventrally; 4, distal portion of style ventrally. *Deltocephalus youngi*, n. sp.: 5, aedeagus laterally; 6, aedeagal apex dorsally; 7, distal portion of style ventrally; 8, aedeagus ventrally. *Deltocephalus buysi*, n. sp.: 9, aedeagus

Female Genitalia: Female unknown.

Types: Holotype (USNM Type No. 67197) and two paratype males, Punta Gorda, British Honduras, August, 1934. Specimens originally in the John L. Buys Collection recently acquired by the U. S. National Museum.

Remarks: The coloration and markings are not distinctive, but the male genitalia readily distinguish *buysi* from all other members of the genus. The species is named for the late Dr. John L. Buys whose doctoral thesis (1924, Cornell Univ. Agr. Exp. Sta., Memoir 80) was one of the earliest studies on the importance of the concealed male genitalia in leafhopper classification.

***Deltocephalus posadai*, new species**

(Figs. 13-17)

Length: 3.0-3.5 mm.

Structure: Crown in dorsal view bluntly angular, median length two-fifths shorter than narrowest width between eyes. Forewing with central preapical cell not divided.

Coloration: Venter largely black but variably touched with sordid yellow. Legs sordid yellow variably touched with black or dark brown. Face sordid yellow heavily marked with black on sutures and clypeus. Usual dark clypeal arcs present. Crown sordid yellow with six black apical spots which may be variably fused and appear as a band. Additional ill-defined dark markings on coronal disc present or absent. Pronotum sordid stramineous to brownish with or without five more or less distinct pale narrow longitudinal stripes. Forewings light brown hyaline with veins pale, margins of cells infuscated.

Male Genitalia: Aedeagus in lateral view moderately elongated, narrowed and slightly upcurved on distal one-third, a distinct fin present on shaft (Fig. 15). Gonopore at extreme aedeagal apex (Figs. 14 & 16). Aedeagus in ventral view with fins appearing as lateral bulges, distinct tooth on either side of notched apex (Fig. 17). Style undistinguished (Fig. 13).

Female Genitalia: Posterior margin of pregenital sternum concave.

Types: Holotype (USNM Type No. 67198) and three paratype males, Usme, Cundinamarca, Colombia, 19 April 1956, elevation 3,120 ft, L. Posada, on *Solanum tuberosum andigena*. Allotype female, Funza, Cundinamarca, Colombia, 12 April 1955, elevation 2,550 ft, L. Posada, on *Solanum tuberosum andigena*. Additional female paratype with same

←
and connective laterally; 10, aedeagal apex posteriorly; 11, distal portion of style ventrally; 12, aedeagus ventrally. *Deltocephalus posadai*, n. sp.: 13, style ventrally; 14, aedeagal apex dorsally; 15, aedeagus laterally; 16, aedeagal apex ventrally; 17, aedeagus ventrally. *Deltocephalus jaraxus*, n. sp.: 18, distal portion of style ventrally; 19, aedeagal apex ventrolaterally; 20, aedeagus laterally; 21, aedeagus ventrally.

data except Duitama, Boyacá, Colombia, 12 April 1956, elevation 2,590 ft.

Remarks: The coloration and markings are highly variable in *posadai*. Specific determination depends almost entirely upon the unique aedeagus. The species is named for the collector, Mr. L. Posada.

***Deltocephalus jaraxus*, new species**

(Figs. 18–21)

Length: 4.0 mm.

Structure: Crown in dorsal view bluntly angular, median length about a fourth shorter than narrowest width between eyes. Forewing with central preapical cell divided by a crossvein.

Coloration: Venter, legs, and face as in *buysi* n. sp. Crown light brown, four small dark brown spots on anterior margin, a transverse brown band between the anterior margins of the eyes, band is widest and broken at middle. Pronotum light brown with five narrow pale longitudinal stripes. Scutellum light brown touched with dark brown. Forewings brown hyaline, veins pale stramineous, cells heavily but variably infuscated.

Male Genitalia: Aedeagus in lateral view moderately elongated, stoutest at middle with a distinct basal heel, and gradually narrowed and upturned distally with a preapical dorsal notch (Fig. 20). Gonopore at base of deeply cleft aedeagal apex (Fig. 19). Aedeagus in ventral view with basal heel and apical cleft distinct (Fig. 21). Distal portion of style with mesal lobe curved laterad (Fig. 18).

Female Genitalia: Female unknown.

Types: Holotype (USNM Type No. 67200) male, Boca del Río, Veracruz, Mexico, 16 July 1964, Ryckman, Christianson, and Lee. Paratype male, east of Mazatlán, Sinaloa, Mexico, 15 August 1954, Ryckman, Christianson, and Lee.

Remarks: Though the coloration and markings are useful, recognition of *jaraxus* is dependent upon the unique male genital structures.

***Deltocephalus pallus*, new species**

(Figs. 44–48)

Length: 3.2 mm.

Structure: Crown in dorsal view bluntly angular, median length approximately a fourth shorter than narrowest width between eyes. Forewing with central preapical cell divided by a crossvein.

Coloration: Venter and legs uniformly light brown. Face marked as in *youngi* n. sp. Crown light brown with a pair of minute dark apical spots and a weakly defined elongate mark behind each ocellus. Pronotum light brown and without definite markings. Scutellum yellowish, unmarked. Forewings light brown hyaline with veins whitish.

Male Genitalia: Aedeagus in lateral view moderately stout and abrupt-

ly upturned, a small tooth on venter of shaft and preapically on bulbous terminus (Figs. 44 & 48). Gonopore preapical on venter of shaft (Fig. 45). Connective short (Figs. 44 & 46). Style undistinguished (Fig. 47).

Female Genitalia: Female unknown.

Types: Holotype (USNM Type No. 67201) male and one paratype male, Punta Gorda, British Honduras, February, 1935. Specimens originally in John L. Buys Collection recently acquired by the U. S. National Museum.

Remarks: On the basis of male genitalia, *pallus* is closely related to the well-known and widely distributed *D. flavicosta* (Stål). *D. pallus* is a comparatively pale species while *flavicosta* is much darker. The pale brown ground color with the darkly colored central portion of the face makes *pallus* and *youngi* n. sp. appear externally much alike; they are easily separated, however, on the basis of male genital structures.

***Graminella lambda*, new species**

(Figs. 22–24)

Length: 3.0–3.5 mm.

Structure: Crown in dorsal view bluntly angular, median length approximately a fourth shorter than narrowest width between eyes. Forewing with central preapical cell undivided.

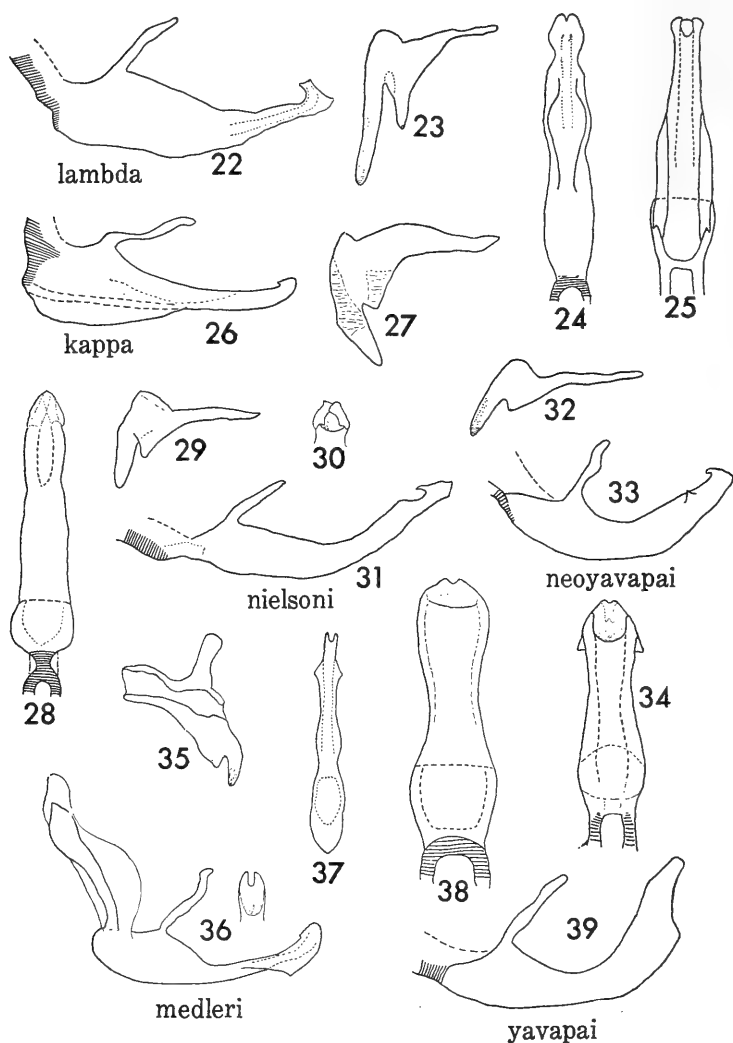
Coloration: Venter of abdomen and thorax largely dark brown to black. Legs sordid stramineous, lightly touched with brown. Face yellow, irregularly marked with brown as arcs on clypeus and as lines on sutures. Crown as in *inca* n. sp. Pronotum sordid stramineous to brownish with or without four vague longitudinal brown stripes. Scutellum yellow, usually unmarked. Forewings basically sordid white to pale brown hyaline, often, but not always, touched with brown particularly at first crossvein between sectors and at claval apices.

Male Genitalia: Aedeagus in lateral view stoutest basally, narrowing to sharply recurved truncate apex (Fig. 22). Gonopore at apex. Aedeagus in ventral view quite uniformly narrow, laterally indented preapically, and notched apically (Fig. 24). Both mesal and lateral lobes of style comparatively long (Fig. 23).

Female Genitalia: Posterior margin of pregenital sternum broadly indented with a wide, blunt tooth at center.

Types: Holotype (USNM Type No. 67202) male, allotype female, and seventeen paratypes, Lake Amatitlan, Guatemala, 4,000 ft, 18 March 1950, J. M. Brennan. Additional paratypes as follows: one, Tampico, Mexico, 29 December 1908; one, Depto. Escuintla, Guatemala, 4 May 1950, J. M. Brennan; one, 12 km west of Olanchito, Honduras, 22 June 1949, E. C. Becker; and one, Kenscoff, Haiti, 18 January 1948, G. N. Wolcott.

Remarks: *G. lambda* can be distinguished with certainty only by the unique male genitalia.



Figs. 22-39.—*Graminella lambda*, n. sp.: 22, aedeagus laterally; 23, distal portion of style ventrally; 24, aedeagus ventrally. *Graminella kappa*, n. sp.: 25, aedeagus ventrally; 26, aedeagus laterally; 27, distal portion of style ventrally. *Graminella nielsoni*, n. sp.: 28, aedeagus ventrally; 29, distal portion of style ventrally; 30, aedeagal apex dorsally; 31, aedeagus laterally. *Polyamia neoyavapai*, n. sp.: 32, distal portion of style ventrally; 33, aedeagus laterally; 34, aedeagus ventrally. *Grami-*

***Graminella kappa*, new species**

(Figs. 25-27)

Length: 3.4-3.7 mm.*Structure*: Crown in dorsal view bluntly angular, median length approximately a fourth shorter than narrowest width between eyes. Forewing with central preapical cell undivided.*Coloration*: Identical in all respects to *inca* n. sp. except for differences in the longitudinal paired stripes on the face. In *inca* the stripes are unbroken and uniformly dark, while in *kappa* the uppermost portion of each stripe is almost always separated giving the appearance of two large irregular spots. These spots are usually darker than the other facial markings.*Male Genitalia*: Aedeagus in lateral view nearly straight with shaft narrowed, a slight notch dorsally near apex, and a finlike expansion basally (Fig. 26). Aedeagus in ventral view moderately slender, narrowing distally, with gonopore at apex (Fig. 25). Distal portion of style undistinguished (Fig. 27).*Female Genitalia*: Posterior margin of pregenital sternum broadly indented with a wide, blunt tooth at center.*Types*: Holotype (USNM Type No. 67203) male, allotype female, and eight paratypes, Punta Gorda, British Honduras, August 1934. Additional paratypes as follows: Three, Rio Temas, British Honduras, August, 1937, A. J. White; one LaLola, Costa Rica, 29 April 1957, M. J. Stelzer; sixteen, Depto. Escuintla, Guatemala, 5 April 1950, 1,000 ft, J. M. Brennan; one, Olanchito, Honduras, 30 July 1949, E. C. Becker.*Remarks*: The coloration and markings of *kappa* are essentially identical to those of *G. striatella* Linnavuori. However, the male genitalia are unique.***Graminella nielsoni*, new species**

(Figs. 28-31)

Length: 3.75 mm.*Structure*: Crown in dorsal view bluntly angular, median length one-fifth shorter than narrowest width between eyes. Forewing with central preapical cell undivided.*Coloration*: Uniformly stramineous except for sparse embrowning on abdomen and four minute spots on anterior margin of crown. Median pair of marginal spots pale brown, lateral pair dark brown. Ocelli black. Pronotum, scutellum, and forewings without definite markings.

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nella medleri, n. sp.: 35, style ventrally; 36, aedeagus and connective laterally with posterior view of aedeagal apex above; 37, aedeagus ventrally. *Polyamia yavapai* (Tuthill): 38, aedeagus ventrally; 39, aedeagus laterally.

Male Genitalia: Aedeagus in lateral view of rather uniform stoutness, only slightly recurved distally, and terminating with a basally directed beak (Fig. 31). Gonopore apical (Fig. 30). Aedeagus in ventral view elongated and moderately stout (Fig. 28). Apex of style undistinguished (Fig. 29).

Female Genitalia: Female unknown.

Types: Holotype (USNM Type No. 67204) male, Huachuca, Arizona, U.S.A., 30 July 1935, E. D. Ball. Paratype male (badly broken), 53 miles south of Marathon, Texas, U.S.A., 23 June 1947, R. H. Beamer.

Remarks: The coloration and markings of *nielsoni* are similar to those of the rare *G. virginiana* DeLong and Mohr. The male genitalia are very different in the two species. The geographical distribution is also very different; *G. virginiana* is known only from Cape Charles, Virginia, while *nielsoni* is known only from Arizona and Texas. The species is named for Dr. M. W. Nielson whose works have clarified the species of several difficult leafhopper genera.

***Graminella medleri*, new species**

(Figs. 35–37)

Length: 3.75 mm.

Structure: Crown in dorsal view bluntly angular, median length approximately one-fourth shorter than narrowest width between eyes. Forewing with central preapical cell divided by a crossvein.

Coloration: Indistinguishable from *inca* n. sp. except for intensity of facial markings. The paired longitudinal facial stripes are barely discernible in *medleri* and are very distinct in *inca*.

Male Genitalia: Aedeagus in lateral view rounded basally with shaft narrowing at middle, distal portion with a ventral fin, and a dorsal preapical notch (Fig. 36). Gonopore on venter of shaft (Fig. 36). Aedeagus in ventral view almost uniformly narrow with preapical fins and apical notch (Fig. 37). Style undistinguished (Fig. 35).

Female Genitalia: Female unknown.

Types: Holotype (USNM Type No. 67205) male, Rio Grande, British Honduras, June, 1932, J. J. White.

Remarks: *G. medleri* is very close to *inca* in coloration. The two species are readily separable on the basis of male genitalia, and by the central preapical cell of the forewing which is divided in *medleri* and undivided in *inca*. The species is named for Dr. J. T. Medler who has published several fine generic revisions of American leafhoppers.

***Graminella inca*, new species**

(Figs. 55–57)

Length: 3.3 mm.

Structure: Crown in dorsal view bluntly angular, median length one-fourth shorter than narrowest width between eyes. Forewing with central preapical cell undivided.

Coloration: Venter of abdomen and thorax dark brown. Legs sordid stramineous, irregularly touched with brown. Face yellow with a pair of solid dark brown longitudinal stripes running from dorsal margin and converging at apex of clypellus. Irregular dark brown spot under each eye converging distally on each side with longitudinal stripe. Crown sordid yellow with two pairs of dark brown or black anterior marginal spots. The central apical pair are minute while the lateral pair are very large. Pronotum sordid yellow with a wide light brown transverse band on posterior margin and an irregular embrowning on anterior margin. Scutellum sordid yellow without definite markings. Forewings brown hyaline with veins sharply distinct due to sordid yellow coloration.

Male Genitalia: Aedeagus in lateral view with large mesal fin and a ventral extension at extreme upturned apex (Fig. 57). Gonopore apical. Aedeagus in ventral view rounded basally, narrowed distally and with a pair of large lateral fins (Fig. 55). Distal portion of style undistinguished (Fig. 56).

Female Genitalia: Female unknown.

Types: Holotype (USNM Type No. 67206) male, Cojimies, Manabi, Ecuador, 12 August 1949, W. Clark-Macintyre.

Remarks: While the habitus and coloration are typical of several species of *Graminella*, *inca* presents the most peculiar and distinctive aedeagus possessed by any member of the genus. Also see remarks under *Graminella medleri*, n. sp.

***Polyamia neoyavapai*, new species**

(Figs. 32-34)

Length: 3.0-3.6 mm.

Structure: Crown in dorsal view comparatively sharply angular, median length equal to narrowest width between eyes. Forewing with many extra crossveins except in brachial cell, anterior costal area, and outer discal cell.

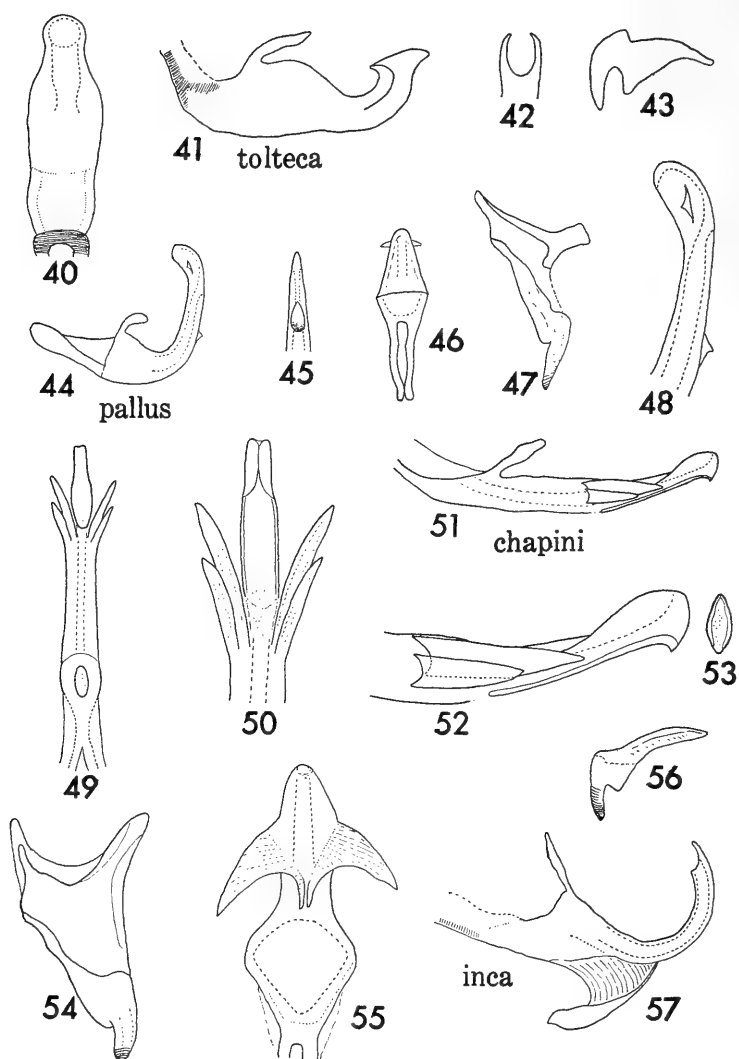
Coloration: Indistinguishable from *P. yavapai* (Tuthill) with ground color yellowish brown, often washed with pink or red.

Male Genitalia: Aedeagus in lateral view moderately stout, gradually upturned distally, and with both a dorsal preapical tooth and a proximal beak at apex (Fig. 33). Aedeagus in ventral view with large gonopore, paired preapical teeth, and moderately elongate shape (Fig. 34). Distal portion of style undistinguished (Fig. 32).

Female Genitalia: Posterior margin of pregenital sternum slightly indented mesally and with a broad, blunt tooth at center.

Types: Holotype (USNM Type No. 67207) male, allotype female, and twenty-one paratypes, foothills Huachuca Mountains, Arizona, U.S.A., 10 October 1937, P. W. Oman.

Remarks: *P. neoyavapai* and *P. yavapai* (Tuthill) are grossly inseparable, although *yavapai* does tend to have a few less extra crossveins in the forewing. The species are separated easily on the basis of male



Figs. 40-57.—*Polyamia tolteca*, n. sp.: 40, aedeagus ventrally; 41, aedeagus laterally; 42, aedeagal apex posteriorly; 43, distal portion of style ventrally. *Deltocephalus pallus*, n. sp.: 44, aedeagus and connective laterally; 45, aedeagal apex posteriorly; 46, aedeagus and connective ventrally; 47, style ventrally; 48, distal portion of aedeagus laterally. *Quaziptus chapini*, n. g. and n. sp.: 49, aedeagus dorsally; 50, distal

genitalia; figures 38 and 39 show the ventral and lateral views of the previously unillustrated aedeagus of *yavapai*, and figures 34 and 33 show the same structure of *neoyavapai*.

***Polyamia tolteca*, new species**

(Figs. 40-43)

Length: 2.4-2.6 mm.

Structure: Crown in dorsal view bluntly angular, median length approximately one-fourth shorter than narrowest width between eyes. Forewing with extra crossveins in clavus only and with central pre-apical cell divided by a crossvein.

Coloration: Venter, legs, and face mainly black with anterior tibiae and distal portion of anterior femora stramineous. Some additional ill-defined stramineous touches on other legs as well. Crown stramineous with four small brown spots on anterior margin (in holotype, the lateral pair of spots are obsolete) and two irregular triangular black marks between anterior margins of eyes. These markings could be interpreted as an irregular transverse band between the anterior margins of the eyes which is widest and broken at the center of the crown and broken often near each eye. Pronotum stramineous with a few irregular dark brown areas near anterior margin. Scutellum stramineous, marked with brown. Forewings sordid milky-white hyaline with many cells heavily infuscated at margins.

Male Genitalia: Aedeagus in lateral view robust, upturned distally, and expanded proximally and distally at apex (Fig. 41). Gonopore at cleft apex (Fig. 42). Aedeagus in ventral view bottle-shaped (Fig. 40). Mesal and lateral lobes of style as illustrated (Fig. 43).

Female Genitalia: Posterior margin of pregenital sternum strongly indented with base of indentation transverse.

Types: Holotype (USNM Type No. 67208) male and allotype female, 20 miles west of Morelia, Michoacán, Mexico, 19 July 1955, R. B. and J. M. Selander.

Remarks: The markings on the crown in *tolteca* are quite similar to *P. weedi* (Van Duzee), a common eastern North American species, as well as to several other species found in the United States. Within a restricted area of Mexico, the coloration of *tolteca* might be diagnostic for the species. However, the male genitalia are unique and readily distinguish *tolteca* from all other species of *Polyamia*.

***Quaziptus*, new genus**

Type-species *Quaziptus chapini*, new species.

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portion of aedeagus dorsally; 51, aedeagus laterally; 52, distal portion of aedeagus laterally; 53, aedeagal apex posteriorly; 54, style ventrally. *Graminella inca*, n. sp.: 55, aedeagus ventrally; 56, distal portion of style ventrally; 57, aedeagus laterally.

Head wider than pronotum, anterior margin rounded to front; antennae long, three-fourths as long as length of body; clypeal suture distinct, face not strongly convex; crown flat, median length slightly exceeding length next to eye; forewings subhyaline, veins distinct, two cross veins between sectors. Male genitalia: Aedeagus moderately slender, elongated, with preapical processes; distal portions of aedeagus weakly united to basal portion; connective closed Y-shaped and solidly fused with aedeagus; style undistinguished. Color stramineous with darker markings.

Quaziptus resembles somewhat members of the North American genus *Commellus* Osborn and Ball. However, this resemblance is superficial. Its relationship is seemingly closer to species of *Psammotettix* Haupt and other deltocephaline leafhoppers having the closed Y-shaped connective. The weakly united distal portion of the aedeagus is unique among leafhoppers known to me.

***Quaziptus chapini*, new species**

(Figs. 49–54)

Length: 3.2 mm.

Structure: Crown in dorsal view bluntly angular, median length equal to narrowest width between eyes. Forewing with central preapical cell undivided.

Coloration: Ground color stramineous and marked with brown as follows: irregular spots on legs and venter of thorax; on facial sutures; usual clypeal arcs; four highly irregular anterior marginal spots on crown (dark brown to black), the apical pair tri-radial, and the lateral pair irregularly crescent-shaped, one around each ocellus; a pair of longitudinal dorsal stripes (pale brown) extending from lateral marginal spots posteriorly across pronotum and scutellum, each dorsal stripe flanked laterally on the pronotum by two weakly defined stripes of the same hue (making a total of six pronotal stripes); cells of forewings infuscated, most heavily in claval areas.

Male Genitalia: Aedeagus in lateral view slender, transverse, with two lateral preapical processes, and enlarged apex with ventral beak (Figs. 51 & 52). Gonopore at extreme apex (Fig. 53). Aedeagus in dorsal view slender, four anteriorly directed preapical processes (inner pair longer), and the extreme distal portion of shaft weakly united at base of preapical processes (Figs. 49 & 50). Style undistinguished (Fig. 54).

Female Genitalia: Female unknown.

Type: Holotype (USNM Type No. 67209) male, 3,300 meters above Guasca, Cundinamarca, Colombia, 8 March 1942, E. A. Chapin.

Remarks: This singular species is named for the collector, Dr. E. A. Chapin, former curator of entomology at the United States National Museum.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

AN INTERGENERIC HYBRID
FLYCATCHER (*CONTOPUS* × *EMPIDONAX*)
FROM IDAHO

By

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On June 20, 1948, Burleigh collected a flycatcher in underbrush bordering a stream in a ravine near Moscow, Idaho. When sent with other specimens to the Fish and Wildlife Service at the U. S. National Museum it was examined by Dr. John W. Aldrich, who identified it as a hybrid *Contopus virens* (= *sordidulus*) × *Empidonax traillii*. The press of other work has prevented Burleigh from publishing a report on this interesting bird prior to now. Aldrich called the specimen to Short's attention in 1963. The senior author had accumulated considerable data concerning wood pewees, and with specimens of both species available to him in the national collection, he began collaboration on this report with Burleigh. The latter noted that adjacent to the ravine where he secured the specimen was a low ridge covered with ponderosa pines. Thus, habitats of the two species were found adjacent to the site where the bird was taken. The specimen proved to be a male in plumage not badly worn for a late June bird. We confirm that the specimen is a hybrid between the distinctive western wood pewee and Traill's flycatcher. The only other published report concerning a definite tyrannid hybrid appears to be that of W. Meise describing a *Tyrannus* × *Empidonomus* cross (1949: 61-83 in the Festschrift zum 60 Geburtstag von Erwin Stresemann).

We wish to express our gratitude to Dr. John W. Aldrich for originally identifying the hybrid, for calling the specimen to the senior author's attention, and for helpful comments and critical perusal of the manuscript. We thank Dr. Allan R. Phillips for supplying references, and for valuable suggestions benefiting our investigation and this report, and Dr. Ned K. Johnson for helpful comments concerning the manuscript.

DESCRIPTION AND COMPARISON

General Appearance: In the sum of its color features the hybrid is more like *Empidonax traillii* than *Contopus sordidulus*. However, it is grayer above and duskier, with less yellowish, below than *traillii*. The specimen is intermediate between the two species in size and proportions. It is distinctive in both size and color; considering all aspects of its coloration, it is not encompassed within the range of variation of *traillii*.

Head Color: The bill is dark above and pale below, as in *traillii* and unlike *sordidulus*. Its rictal bristles are intermediate between those of *traillii* and *sordidulus*, being not as fine as in the former, nor as strong and thick as in the latter species. The throat is mostly white with almost no yellow tinge. The white area is restricted posteriorly, and somewhat ill-defined due to the feathers being so worn that gray shows through from their bases. The color of the ear coverts and sides of the neck is gray-brown, nearly as in *sordidulus* (slightly less gray). There is a faint greenish tinge, much less evident than in Idaho specimens of *Empidonax traillii adastus*. The hind neck is gray-green, nearest that of *E. t. extimus*, but slightly grayer. Feathers of the crown are gray-green with dark brown centers and bases, about as in *traillii*, but with feather edges a trifle grayer and less greenish. Although crests are difficult to distinguish in some skins, the specimen exhibits a moderately well-defined crest, similar to that of *sordidulus* and not reduced as in *traillii*. Its eye-ring is narrow, intermediate between the broader ring of *traillii* and the very restricted one (visible microscopically) of *sordidulus*.

Color of Underparts: The hybrid's breast is dusky gray, with little indication of pale yellow in the feather edges. In this character the specimen does not show a close approach to *sordidulus*; however, it is grayer, and less brown and olive-yellow than in all *E. t. adastus* examined. The gray passes posteriorly to the sides more broadly than in *traillii*. The sides and flanks of the specimen are darker than in *traillii*, but not as dark as in *sordidulus*. The hybrid's belly is dull white with faint traces of dusky and a light yellow wash. Less yellow is shown than in all (even worn) *E. t. adastus* and *extimus* specimens examined. There is no distinct border between its belly and breast, for

all the dull white of the belly grades imperceptibly into the dusky gray of the breast. Generally, the specimen is thus grayer and duskier below and with less yellowish and white than *traillii*, but is not as dark as *sordidulus*. The undertail coverts are white with a faint yellow wash (matched by a few *traillii*), but lacking traces of the dusky coloring about the feather shafts typical of *sordidulus*.

Back Color: The back of the hybrid is grayish olive-brown, thus tending slightly toward *sordidulus*. The rump, especially, is grayer than in *traillii* and approaching *sordidulus*. Only two worn specimens of *E. t. extimus* and one of *E. t. adastus* match the hybrid in back and rump color.

Tail Color: The hybrid's tail is dark brown, nearly as dark as in some *sordidulus*, and somewhat darker than in *traillii*. Its outer rectrices have pale outer vanes as in *traillii*.

Tail Shape: The shape of the hybrid's tail is intermediate between the extremely notched tail of *sordidulus* and the rounded tail of *traillii*. In *sordidulus*, the innermost rectrix (No. 1) is much shorter than the outer one (No. 6). Rectrix 5 is usually the longest, and numbers 4, 3 and 2 sharply diminish in length toward number 1. Traill's flycatchers show no notch in the tail, or but a trace of one. Rectrix 1 is longer than number 6, and nearly as long as number 2, which is the longest rectrix in this species. Rectrices 3-5 diminish in length going outward toward number 6. The hybrid's tail is notched, but not as deeply as in *sordidulus*. Rectrix 1 is smaller than number 6, and rectrix 5 is the longest. However, since rectrix 1 is longer in the hybrid than in *sordidulus*, rectrices 2-4 gently increase in length outward toward number 5. The curve formed by the feather tips thus slopes gently as in *traillii*, but in the opposite direction (the rectrices increase, rather than decrease in length from number 2 to number 5).

Wing Color: The general coloration of the hybrid's wings is brown as in *traillii*, not sooty as in *sordidulus*. Its wing-bars are narrower than in *traillii* (especially the anterior bar). The color of the wingbars is dusky with some white and no yellow wash. In this respect the specimen is somewhat intermediate, but more like *traillii* than *sordidulus*.

Wing Shape: The hybrid's wings are intermediate in shape between the longer, more pointed wings of *sordidulus* and the shorter, more rounded wings of *traillii* (see Table 1). The tenth primary is usually longer than the sixth in *sordidulus*, while it is usually shorter than the fifth primary (may be the same size or slightly longer) in *traillii*. In the hybrid P 10 is a little shorter than P 6 and much longer than P 5.

Wing Edge: The small underwing coverts at the bend of the wing (= "wrist" of some authors) are yellowish white in *traillii*, with dark bases which occasionally extend far enough toward the feather tips to present a slightly mottled appearance. The same feathers are dark sooty brown with small buff or yellow-buff edges in *sordidulus*. The hybrid exhibits dull brownish feathers with some gray and buff traces, and with dark basal feather areas producing mottling. The hybrid is

TABLE 1.—Comparison of some characters of the hybrid with *Contopus sordidulus* and *Empidonax traillii**

| Character | <i>E. traillii</i> | | Hybrid | <i>C. sordidulus</i> | |
|-----------------------------|--|-----------------------------------|----------------------|--|--------------|
| | N | Range | | N | Range |
| Wing length | 100 | 67.5–76.5 mm (50 67.6–73.6 mm) | 78.0 mm | 88 | 80.1–91.6 mm |
| Longest primary–P6 | 46 | 2.5– 7.0 mm | 11.0 mm | 50 | 11.5–15.5 mm |
| Tail length | 94 | 55.0–63.9 mm (49 56.9–63.9 mm) | 62.5 mm | 88 | 59.2–71.3 mm |
| Wing length– tail length | 47 | 6.0–13.6 mm | 15.5 mm | 85 | 18.5–25.3 mm |
| Bill length | 47 | 8.4–10.8 mm | 8.9 mm | 85 | 8.5–11.8 mm |
| Bill width | 30 | 5.5– 6.7 mm | 6.0 mm | 40 | 6.3– 7.0 mm |
| Bill tip | Hook strongly joined at base to broadening mandible. | | As <i>sordidulus</i> | Hook narrow at base, joining finely tapering mandible. | |
| Tarsal length | 50 | 14.6–16.4 mm | 14.5 mm | 88 | 11.5–13.9 mm |
| Tail length | 49 | 0.81–0.89 | 0.80 | 87 | 0.72–0.79 |
| Wing length | | | | | |
| Wing L.–tail L. | 47 | 0.37–0.88 | 1.07 | 85 | 1.32–2.16 |
| Tarsal length | | | | | |
| Tarsal length | 50 | 0.21–0.24 | 0.185 | 79 | 0.14–0.17 |
| Wing length | | | | | |
| Bend of wing | Yellowish–white | | Dull, brownish | Dark brown | |
| Wing shape | Wing shorter, more rounded | | Wing intermediate | Wing longer, more pointed | |
| Tail shape | Rounded | | Notched | Strongly notched | |

* All specimens presumed breeding males. *Contopus* from all over western U. S. and western Canada. Large ($N=100$) wing and tail length sample for western *E. traillii* taken from Stein (1963, Proc. Amer. Phil. Soc., 107:21–50). Smaller *traillii* sample (45–50) comprised of breeding specimens of *E. t. adastus* and *E. t. extimus* in U. S. National Museum collection.

intermediate in this feature, and matches some *Contopus virens* specimens in the color of these underwing coverts.

Measurements: The western wood pewee and Traill's flycatcher overlap in bill length, bill depth and tail length, but not in wing length, difference between longest primary and P 6, wing length less tail length and tarsal length (Table 1). The hybrid is intermediate in all four measurements in which the two species show complete separation. Although there is overlap between these species in the first three measurements mentioned, the hybrid falls near the mean for *traillii* in each

character, and away from all but the extreme lower range of *sordidulus* (completely below *sordidulus*' range in bill width at nostril). The shape of the hybrid's bill hook is like that of *sordidulus* rather than *traillii* (Table 1).

Proportions: There was no overlap between *C. sordidulus* and *E. traillii* in three ratios which were utilized (Table 1). The hybrid is clearly intermediate in all three ratios.

Thus, the specimen is intermediate in a number of characters; it approaches *traillii* in some, and *sordidulus* in still other features. Thanks to the existence of certain clear-cut differences between these species, the general intermediacy of the specimen is apparent. It is evident that the specimen is a hybrid, and does not represent a rare, extreme variant of one or the other species.

DISCUSSION

This instance of hybridization has implications in the taxonomy of these flycatchers. The fairly close relationship of the genera *Contopus* and *Empidonax* implied in our current classification (1957, A.O.U. Check-list, 5th Ed.) is upheld by this evidence that genomes of species in the two genera are sufficiently similar to allow production and survival (for nearly one year, at least) of an F¹ hybrid. A second point concerns possible intrageneric hybrids in *Contopus* and *Empidonax*. That two species belonging to different genera, with different habits occupying different habitats, can on occasion interbreed, suggests that *occasional* hybridization may occur between presumably more closely related species within each of these genera. Breakdown of isolating mechanisms between genetically more similar congeneric species generally ought to permit as frequent hybridization as that occurring between species of different genera, which are likely to differ genetically to a much greater degree. Taxonomists dealing with species (particularly those which are largely allopatric, and hence might have less effective isolating mechanisms) in these genera should watch for and critically appraise all extreme "variants" which are encountered, to ascertain whether these might be hybrids. This is not to say that intrageneric hybrids within the genera *Contopus* and *Empidonax* will prove to be common, but that they may at least occur.

PROCEEDINGS
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TWO NEW SUBSPECIES OF THE ANGUID LIZARD
WETMORENA FROM HISPANIOLA

BY ALBERT SCHWARTZ

The island of Hispaniola is inhabited by three genera of anguid lizards: *Diploglossus* Wiegmann, which is widespread in both Haiti and the República Dominicana; *Sauresia* Gray, which has a similar distribution but which has recently been regarded as doubtfully separable from *Diploglossus* by Underwood (1959:11), and *Wetmorena* Cochran. The latter genus is monotypic, and has heretofore been known only from the eastern portion of the Massif de la Selle in Haiti; Cochran (1941:262) mentioned specimens from the Mont des Agents Commissaires, near La Visite, Mont Cabaio, and Mont de la Selle, from west to east. Since the Massif de la Selle grades imperceptibly into the Dominican Sierra de Baoruco, without any major geographic feature to divide the two ranges, it was considered not improbable that *Wetmorena* occurred also in the latter range. In fact, prior to Dr. Cochran's herpetology of Hispaniola, at least one Dominican specimen of *Wetmorena* had been collected by W. G. Hassler at Polo in 1932.

In the summer of 1963, Patricia A. Heinlein, David C. Leber, Ronald F. Klinikowski, Richard Thomas and I visited the Sierra de Baoruco, and a series of *Wetmorena* was taken at moderate elevations in these mountains. Previously, in the summer of 1962, Dennis R. Paulson, Miss Heinlein, and Messrs. Leber and Klinikowski visited the area called the Forêt des Pins in the extreme eastern edge of the Massif de la Selle, and there secured a large series of these lizards. When these two series are compared with one another, and additionally compared with material from more eastern La Selle localities it is obvious that three distinct populations of *Wetmorena* are involved. The present large series of *Wetmorena* would not have been collected without the capable

assistance of the above colleagues; I have borrowed specimens for comparison from Dr. Ernest E. Williams of the Museum of Comparative Zoology (MCZ), Dennis R. Paulson (DRP), and Richard Thomas (RT), and wish to thank them for their customary generosity. Paratypes have been deposited in the American Museum of Natural History (AMNH), Museum of Natural History, University of Kansas (KU), and the United States National Museum (USNM). The illustrations are the work of Ronald F. Klinikowski, whom I also wish to thank.

A few comments on Haitian place names are appropriate. Publications by American authors dealing with the Haitian fauna vary in their treatment of Haitian geographical features as well as names of towns or other population centers. Such variations are due to several factors; these include lack of detailed maps of the country, inability to transliterate or understand Haitian *creole* with the result of faulty spellings, translation of Haitian *creole* names into English, and, probably the most common source of uncertainty, the fact that almost every hill, creek, valley, or locality has a locally used name. Use of these latter names without some qualifying distance and direction from a customarily recognized and mapped town are often misleading, difficult for the later worker to locate, or impossible to find on any extant map. Additionally, the same place name may be used repeatedly in various sections of the country (or even in the same general area). Since the same name may be applied to places which differ greatly in elevation and ecology, the simple use of these unlocatable names presents an additional hazard. In an effort to standardize Haitian names (an admittedly almost futile gesture), I have used in the present paper, and will use in succeeding papers, the following two sources: *Géographie d'Haiti*, Paul Pereira, Imprimerie N. A. Theodore, Port-au-Prince, Haiti, and the 28-sheet 1:100,000 map of Haiti printed by Usarcarib Engineers, C.Z. 11-61, and compiled in 1961. The former gives a detailed discussion of the physiographic features and the latter is abundantly annotated with place names. A combination of both, plus the customary oil company maps, facilitates the finding of some—but by no means all—localities used by collectors. Unfortunately, even these two sources are occasionally, and possibly importantly, in disagreement; for instance, Pereira places the Mont des Agents Commissaires to the west of Furcy, whereas the map calls the entire Forêt des Pins region the Mont des Commissaires. These two localities are rather widely separated, and this difference, in the present paper for example, may be crucial. In such cases, without further information, one must be arbitrary in choosing which locality is meant. Also, as has been my custom when dealing with Cuban locality data, I prefer to retain the original (in this case French *creole*) names for all physiographic features and population centers, rather than translating them into English.

Wetmorena haetiana Cochran, as known from the type locality and adjacent localities in the more northern Montagne Noire upon which ridge lies Furcy, is an earless, weak-legged anguid, with an adult snout-vent length varying between 59 and 90 mm. Color-wise, western La Selle specimens dorsally are either unicolor metallic bronze without a pattern, or have a dorsal pattern of scattered dots; the more medial of the dots only occasionally are aligned into two paramedian longitudinal rows. Most striking is the ventral pattern, which is black with large discrete white blotches which extend laterally and dorsally onto the sides, neck, cheeks, and labials (particularly the infralabials) and are especially prominent on the chin. The western population differs also from the Sierra de Baoruco population in scalation as is shown below, and from the Forêt des Pins population in pattern. At Forêt des Pins, the Haitians call *Wetmorena* "sourd," and the race from this area may be named, from the Latin word for "deaf."

***Wetmorena haetiana surda*, new subspecies**

Type: MCZ 77040, an adult male, from Forêt des Pins, 5800', Département de l'Ouest, Haiti, 12 August 1962, by R. F. Klinikowski and natives. Original number X3880.

Paratypes: Albert Schwartz Field Series (ASFS) X1910-12, Forêt des Pins, Dépt. de l'Ouest, Haiti, 30 June 1962, R. F. Klinikowski; AMNH 92079-85, ASFS X3881-83, ASFS X3896-99, ASFS X3912-15, DRP 2450, KU 79715-21, MCZ 77041-48, USNM 150548-53, same data as type; MCZ 61067, Forêt des Pins, Petite Source, Dépt. de l'Ouest, Haiti, 20 February 1959, P. S. Humphrey; MCZ 61068, Forêt des Pins, pines east and northeast of house, Dépt. de l'Ouest, Haiti, 21 February 1959, P. S. Humphrey; MCZ 61069-70, Forêt des Pins, Boucan Chatte, Dépt. de l'Ouest, Haiti, 23 February 1959, P. S. Humphrey.

Diagnosis: A subspecies of *Wetmorena haetiana* characterized by a pair of paramedian dorsal lines, which may occasionally be broken up into longitudinal dashes, the remainder of dorsum with or without about eight rows of longitudinally arranged dashes, venter black with irregularly scattered, small, diffuse pale (gray) areas which are never discrete as in *h. haetiana*, and do not extend onto chin or sides of neck as large whitish blotches. Scalation much as in *h. haetiana*, except that scales around body at axilla and anterior to groin average slightly less.

Description of type: An adult male with a snout-vent length of 81 mm, head width 10.2 mm, tail 69 mm. Scales around body behind axilla, 45; around body just anterior to groin, 36; subdigital lamellae on third toe, 10. Middorsal band 12 scales wide at midbody, dull bronzy with a pair of prominent paramedian longitudinal lines from occiput to above hindlimbs, whence they proceed along upper side of tail in a less clear but nonetheless discernible condition. Head unicolor with back, with some random black flecking. Remainder of dorsum, except for area enclosed by paramedian lines, with about six vague, much fragmented, series of longitudinally arranged dashes, which continue onto the upper

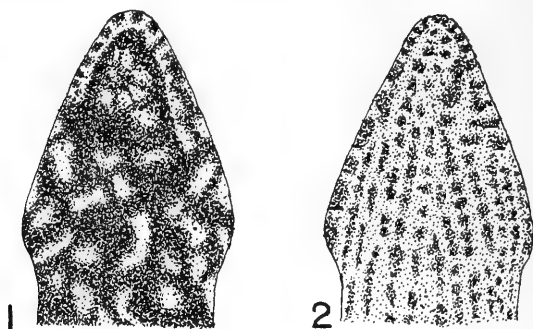


FIG. 1. Ventral view of throat of *Wetmorena haetiana haetiana* (MCZ 67628), showing dark ground color and conspicuous rosettes.

FIG. 2. Ventral view of throat of *Wetmorena haetiana surda* (MCZ 77040, type), showing linear pattern.

surface of the tail (Fig. 3). Sides black, flecked with gray, the black lateral color beginning in the loreal region and extending over the sides of the head as a vague dark mask. Labials dark brown flecked with gray; limbs almost black, and slightly flecked with gray. Venter black and gray, the paler color most prominent on chest, and the black pigment arranged on the belly proper into about four longitudinal lines; in no case on the venter does the pale gray color form large discrete blotches; underside of tail black with some gray dots on the black lateral surfaces.

Variation: The 47 paratypes range in snout-vent length from 97 (MCZ 61067, male) to 35 mm. There is no means of determining sex by scalation; however, adult males are distinctly large headed, and adult females occasionally have developing eggs visible through the pale belly. I have the impression that males reach a larger size than females; this is surely the case in the related genus *Diploglossus*, and is to be expected in *Wetmorena*. The largest female (MCZ 77041) has a snout-vent length of 81 mm and is distinctly slimmer headed than comparably sized males.

Scales around the body anteriorly vary between 41 and 49, posteriorly between 32 and 37; there is a rough difference of 10 scales between the axillary and groin counts in any specimen. The axillary mean is 45.0, the groin mean is 35.4. The third toe subdigital lamellae vary between eight and 11, with nine the modal number (19 individuals).

The width of the dorsal metallic band is either 10, 11, or 12 scales; this count includes the one-half or one-third metallic scales on the edge of the band. Thus, a dorsal band count of 11 means that there are nine scale rows plus two scale rows (one on either side of the band) upon which the metallic color is visible on their medial halves or thirds; a total of 11 scale rows are thus involved in the metallic band coloration. Of the

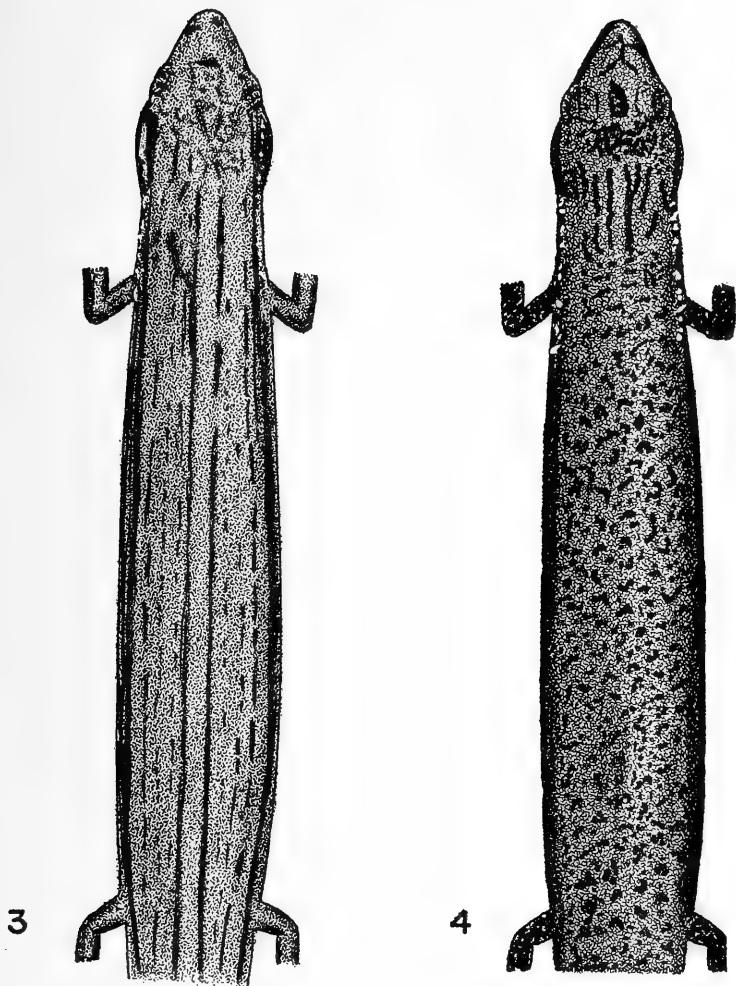


FIG. 3. Dorsal view of *Wetmorena haetiana surda* (MCZ 77040, type).

FIG. 4. Dorsal view of *Wetmorena haetiana mylica* (MCZ 77049, type).

entire series of paratypes (including the type), most (34 specimens) have a dorsal band of 12 scales, with 13 individuals having a band 11 scales wide, and one individual with a ten-scale wide band.

In coloration and pattern, the entire lot is quite uniform. Live individuals were described as "dark bronzy above with black dorsal and

head markings, sides and venter black spotted with gray" or "dorsal ground color from bronzy brown to almost black. Ventral ground color black, often with (but sometimes without) scattered white flecking." In all specimens, the paramedian lines are the most prominent dorsal feature; the remainder of the dorsum may be virtually patternless except for a few scattered dashes, or may have a more or less complete complement of eight longitudinal lines of dashes. The paramedian lines may be somewhat incomplete, and be broken up into longitudinal series of dashes; if so, the integrity of these dashes is obvious, and they form a more prominent and wider line than the adjacent fine longitudinal rows of dashes. The venters are extremely variable; some specimens have the venter entirely black, with some white on the chest and throat; others have few to many scattered small, at times confluent, gray dots on the belly, and the throats are longitudinally lined with black and gray (Fig. 2). Still others have the venter with more gray than black pigment, and thus give the appearance of a gray-bellied lizard with some irregular black dotting or marbling. Such variation is correlated neither with size nor sex.

Comparisons: There are 16 specimens available from the region of the type locality (Mont Cabaio) and other localities in the Massif de la Selle *sensu stricto*, as well as from the region about Furcy (in the Montagne Noire), as follows: MCZ 24536, MCZ 45741-42, Mont Cabaio, Dépt. de l'Ouest; MCZ 37566, Pic la Selle, Dépt. de l'Ouest; MCZ 38269, 38271-76, nr. La Visite, Dépt. de l'Ouest; MCZ 51426 (2 specimens), MCZ 57060, MCZ 67628-29, Furcy, Dépt. de l'Ouest (see Fig. 5 for distribution of subspecies). The five specimens from Furcy agree with the La Selle material in pattern, but differ from the latter in somewhat lower scale counts; thus Furcy lizards have 43 or 45 scales anteriorly about the body, and 34 to 35 posteriorly, whereas La Selle individuals have from 46 to 50 scales anteriorly and 33 to 37 posteriorly. These differences I assume to be due to the small Furcy sample, although it is quite possible that the intervening valley between the Massif de la Selle and the Montagne Noire, in the region near Furcy, might act as a barrier between the two populations. However, the mountain ridges in this particular section are so complex that it seems improbable that the two populations are isolated; for example, immediately to the west of Furcy is a ridge which connects the Montagne Noire to the La Selle.

Differences between the races *surda* and *haetiana* are principally those of pattern. The nominate form is characterized by having a unicolor to dotted dorsum, with occasionally two paramedian rows of dorsal dots—not dashes or lines. Ventrally, the two races are very distinctive. The bellies of *h. haetiana* are black with large, discrete white blotches or rosettes, which extend up onto the sides, and are especially prominent on the neck, cheeks, chin, and labials (Fig. 1). In some individuals, the rosettes are concentrated on the anterior portion of the belly, the posterior being completely black and immaculate. The single pale-

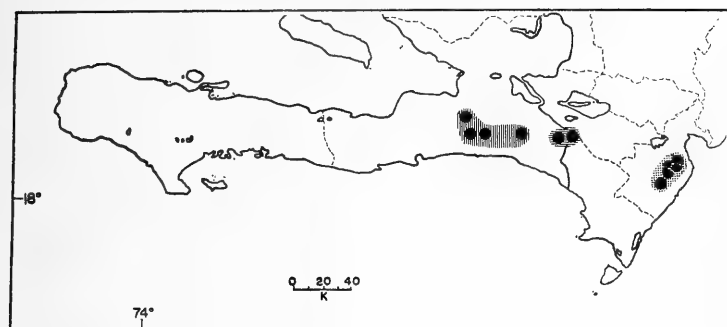


FIG. 5. Southwestern Hispaniola (Tiburon Peninsula), showing distribution of the subspecies of *Wetmorena haetiana*; vertical lines, *haetiana*; horizontal lines, *surda*; fine dots, *mylica*.

bellied individual (MCZ 67629) approaches the condition in *surda*, but lacks the chin and neck lining of the latter, and has extensive pale spotting on the sides of the neck and labials. Cochran (1941:254) described the type as having "about 10 narrow dark brown dorsal stripes of which the central ones are more or less broken up"; these stripes are just barely discernible in the present material and are very fine; I regard them as a series of dots rather than as lines, since they are so often hardly visible as complete lines. Many specimens are patternless or with only the barest indication of dorsal scattered dotting.

Scalewise, *h. haetiana* differs hardly at all from *surda*; in the former, axillary scales around body vary from 43 to 50 (mean, 46.6), in the latter from 51 to 59 (mean, 45.0); posteriorly, the scales around the body in *h. haetiana* vary from 33 to 38 (mean, 36.0), whereas in *surda* they vary between 32 and 37 (mean, 35.4). These differences are not significant.

The populations of *Wetmorena* in the Sierra de Baoruco are distinct from both of the more western populations in Haiti, and for these eastern lizards I propose the name

***Wetmorena haetiana mylica*, new subspecies**

Type: MCZ 77049, an adult male, from 24 km southwest Barahona, 3700' Barahona Province, República Dominicana, taken 2 August 1963, by David C. Leber and Richard Thomas. Original number V161.

Paratypes: MCZ 77050, 10.5 mi. S Cabral, 3500', Barahona Province, R.D., 27 July 1963, D. C. Leber; AMNH 92086-87, 8 km NE Las Auyamas, 2600' Barahona Province, R.D., 28 July 1963, D. C. Leber, R. Thomas; AMNH 92088, ASFS V162-63, ASFS V171-73, ASFS V178, KU 79722-25, MCZ 77051-54, RT 766-67, USNM 150554-57, same data as type; ASFS V185, 21 km SW Barahona, 3000', Barahona Province, R.D., 2 August 1963, R. Thomas; MCZ 77055-56, 10 mi. S

Cabral, 3500', Barahona Province, R.D., 5 August 1963, D. C. Leber; MCZ 43821, Polo, Barahona Province, R.D., September, 1932, W. G. Hassler.

Diagnosis: A subspecies of *Wetmorena haetiana* characterized by a unicolor to dotted dorsum without paramedian lines, rows of dashes, or flecks; occiput and neck often with a series of fine longitudinal lines, and higher counts of scale rows around body.

Description of type: An adult male with a snout-vent length of 88 mm, head width 12.0 mm, tail about 100 mm. Scales around body behind axilla, 50; around body just anterior to groin, 38; subdigital lamellae on third toe, 10. Middorsal band, 13 scales wide at midbody, dull bronzy, completely and densely speckled with fine black dots, not arranged into any longitudinal pattern; occiput and neck with a series of about eight longitudinal lines which become diffuse posterior to the level of the forelimbs; head scales profusely marked with black, so that little of the brown dorsal coloration is apparent (Fig. 4). Top of tail slightly darker than dorsum, likewise dotted with black. Sides, from lores posteriorly onto sides of tail black, with many very small brassy flecks. Labials black, almost unmarked with paler; limbs black. Venter black with irregular scattered or confluent buffy markings, which do not form discrete rosettes; chin black, throat with indications of black longitudinal lines; underside of tail black.

Variation: The 28 specimens range in snout-vent length from 88 mm (the type) to 40 mm; the largest female, which is gravid, has a snout-vent length of 87 mm, and several others approach this female in size. The width of the head of this largest female (USNM 150554) is 9.1 mm, the slimmer head clearly contrasting with the more massive jowl musculature of the adult males.

Scales around the body anteriorly vary between 47 and 56 (mean, 50.7) posteriorly between 36 and 41 (mean, 38.5). The width of the dorsal metallic band is either 11, 12, or 13 scales, with 12 the modal number (16 specimens); only two individuals have counts of 11 and the balance (11 specimens) have counts of 13.

In coloration and pattern, there is much uniformity. The dorsal band ranges from very dark metallic brown to a very pale metallic tan; the black lateral band with its brassy dots is more prominent in light-backed lizards than in dark-backed ones. In none is there an indication of paramedian lines, although all show the fine nuchal lines noted in the type. The dorsum itself may be unpatterned or may be more or less heavily dotted with dark brown to black. In life, the ventral coloration varied between dark brown and black, with the pale areas buffy. There are no clear-cut rosettes or blotches ventrally, and the belly, neck, and throat are variously marked with dark and light without any clear pattern.

Comparisons: From both *haetiana* and *surda*, *mylica* can be distinguished by the higher number of scale rows around the body; although overlap occurs in the number of rows, the means, both anteriorly and posteriorly, between *mylica* on one hand, and *haetiana* and *surda* on the

other, differ significantly. *Wetmorena h. mylica* never shows the paramedian lines of *surda*, and never shows the black venter with large gray rosettes of *haetiana*. Dorsally, *mylica* and *haetiana* are very close, since both have patternless to dotted dorsa; the ventral pattern will easily distinguish them. Also, *mylica* lacks the black neck and cheeks with gray rosettes of *haetiana*, and *haetiana* lacks the finely lined neck of *mylica*.

The number of scale rows involved in the metallic dorsal band deserves special comment. In all subspecies, the modal number of dorsal band scales is 12. However, in the races *haetiana* and *mylica*, counts of 13 occur; in *surda*, despite a series of 48 individuals, none had counts of 13. Additionally, *surda* has individuals with counts of 10 and 11, whereas no *haetiana* has a count of 11 or below. Use of chi square test on these data shows that the differences observed are significant.

The name *mylica* is an allusion to the type locality, which is a mahogany sawmill in the Sierra de Baoruco; these lizards were especially common under piles of round rocks and boards which fringed the sawmill area.

Remarks: As first pointed out by Mertens (1939:11-12), and later much expanded by Williams in several papers, Hispaniola may be faunistically divided into two major areas, the so-called north and south islands, which are divided by the Cul-de-Sac Plain in Haiti and its extension, the Valle de Neiba. *Wetmorena* is a member of the south island fauna, and is now known from the Massif de la Selle and associated ridges immediately to the north (Montagne Noire), and the Sierra de Baoruco. Its presumed absence from the Massif de la Hotte is probably an artifact of collection. In the La Selle region, *Wetmorena* localities range from elevations of 7,500 feet (Mont Cabaio) and 8,800 feet (Mont la Selle) to 5,000 feet (Furcy). The elevation at Forêt des Pins is 5,800 feet. The localities in the Sierra de Baoruco whence *Wetmorena* has been collected range between 3,700 and 2,600 feet. The considerably lower elevations for *mylica* are at once apparent. Whether this apparent difference in elevation between *mylica* and the western races is real cannot be verified; it may be merely an artifact of the extreme cutting and deforestation of the mountainsides in Haiti between, for example, Kenscoff and Pétienville, where *Wetmorena* may once have occurred. However, the entire Sierra de Baoruco area, in addition to being either well forested or planted with coffee (which forms an excellent pseudo-forest for many silvicolous animals), is distinctly more mesic, at least as compared to the Haitian mountains to the south of Pétienville. It is possible that these more mesic conditions have allowed for lower growth of broad-leaf forests in the República Dominicana, and thus have allowed lower penetration of *Wetmorena*.

Williams (1963) has shown that at least one species of south island lizard (*Anolis hendersoni*) has become differentiated into three extremely well-marked races in the La Hotte-La Selle-Baoruco massif. Although the known range of *Wetmorena* is more restricted than the

known range of *A. hendersoni*, apparently somewhat the same factors may have been at work in allowing for the development of three races of *Wetmorena*. The range of *W. h. haetiana* is roughly comparable to the eastern portion of the range of *A. h. hendersoni* (although *Wetmorena* is absent from lower elevation *hendersoni* localities), whereas the range of *A. h. bahorucoensis* embraces the ranges of both *W. h. surda* and *W. h. mylica*. As yet, intergrades between the races of *A. hendersoni* and those of *W. haetiana* are unknown; this may continue to be the case for some time, since access to much of the south island mountain massif is impossible at the present time.

Although some species, which have evolved on the south island, have penetrated onto the north island, there is no evidence that this is true of *Wetmorena*. A logical place to expect the genus on the north island is the Cordillera Central in the República Dominicana. Intensive collecting in this range has yielded no *Wetmorena*, and here the high elevation *Diploglossus darlingtoni* seems to be the ecological equivalent of *Wetmorena*.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

TWO NEW SUBSPECIES OF KANGAROO RATS,
GENUS *DIPDOMYS*

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In the course of revising the banner-tailed kangaroo rats, *Dipodomys spectabilis*, and the desert kangaroo rats, *Dipodomys deserti*, considerably more material has been available for examination than previously was recorded. Specimens of *D. spectabilis* from Sonora, México, previously have not been critically studied and those from the west central part of the State have not been reported before. More specimens of *D. deserti* are now available from the northwestern part of the range of this species. This material provides the basis for the recognition and description of two new subspecies.

Specimens of the two subspecies described in this paper were examined in the collections of either the Museum of Vertebrate Zoölogy, University of California, Berkeley (MVZ), or the Museum of Natural History, University of Kansas, Lawrence (KU). I thank the following persons for the help rendered to me during this study: Seth B. Benson, William Z. Lidicker, Jr., and C. S. Thaler (MVZ) and E. Raymond Hall and J. Knox Jones, Jr. (KU). Capitalized color terms are from Ridgway (1912).

Specimens of *Dipodomys spectabilis* from Sonora, México, are scarce. In his original description of the Arizonan *Dipodomys spectabilis perblandus*, Goldman (1933:467) referred two specimens from Magdalena, Sonora, to this subspecies. Burt (1938:46) lists specimens from Cerro Blanco, from Noria, and from 2 mi. S Sásabe under the name *D. s. perblandus*. Material from Ebano, Sonora, was referred to *D. s. zygomat-*

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icus by Villa (1941:372) and has recently been included with *D. s. perblandus* by Alvarez (1960:406-407). Alvarez (*ibid.*) also records material from La Sauceda, 15 mi. NNE Cananea, and from 9 mi. N Cananea as *D. s. perblandus*. These specimens from near Cananea are here regarded as *D. s. spectabilis*. Specimens from west central Sonora are distinct enough to be recognized as a new subspecies which may be named and characterized as follows:

***Dipodomys spectabilis intermedius*, new subspecies**

Holotype: Female, adult, skin and skull; No. 82782, Museum of Vertebrate Zoölogy, University of California; from 16.7 mi. SW Bámori, 1900± feet, Sonora, México; collected by Seth B. Benson, 25 April 1938, original number 5301.

Paratypes: All from the type-locality: MVZ Nos. 82780-81 ♂♂, 82783-84 ♀♀, 82785-87 ♂♂, and 82788 ♀.

Geographic distribution: West central Sonora.

Known at present from the vicinity of Querobabi on the north, southward to Carbo, and westward to a locality about 17 mi. SW of Bámori. Limits of the range of this subspecies are not well known.

Diagnosis: A small subspecies of *Dipodomys spectabilis* averaging in total length 318.5 to 325.0 mm; tail length, 184.9 to 188.8 mm; ear length about 16.6 mm; distal white tip of the tail short, averaging 20.0 to 21.0 mm; light in weight, averaging 98.9 to 106.1 grams.

Color: Upper parts light ochraceous-buff mixed with pinkish buff; sides with more evident pinkish buff; arietiform markings dusky; plantar stripes light brown; dorsal and ventral tail stripes darkish; subterminal band at end of tail blackish; tuft of hairs at base of tail ventrally grayish.

Skull: Size small; greatest length averaging 43.0 to 43.2 mm; basal length averaging 31.0 mm; breadth across maxillary arches small; posterolateral edge of maxillary arches slightly flared; rostrum narrow; auditory bullae small; greatest breadth across bullae averaging 27.0 to 27.7 mm; supraoccipital and interparietal narrow; least width of supraoccipital averaging 1.7 to 2.0 mm; narrow across exoccipitals; external openings of auditory meatuses oval; incisor usually small; mandible small, mandibular length averaging 17.9 to 18.0 mm. Also see measurements.

Comparisons: Compared with *D. s. perblandus*, *Dipodomys spectabilis intermedius* is more pinkish in color; slightly smaller in total length, tail length, length of hind foot, greatest length of skull, basal length, bullar depth, mandibular length, size of mastoidal bullae, and greatest breadth across bullae; pterygoid foramina slightly larger and directed more anterolaterally; breadth across maxillary arches, nasal length, and least interorbital breadth usually smaller; breadth across exoccipitals usually slightly smaller; interparietal and supraoccipital usually smaller; jugals usually narrower; teeth slightly smaller.

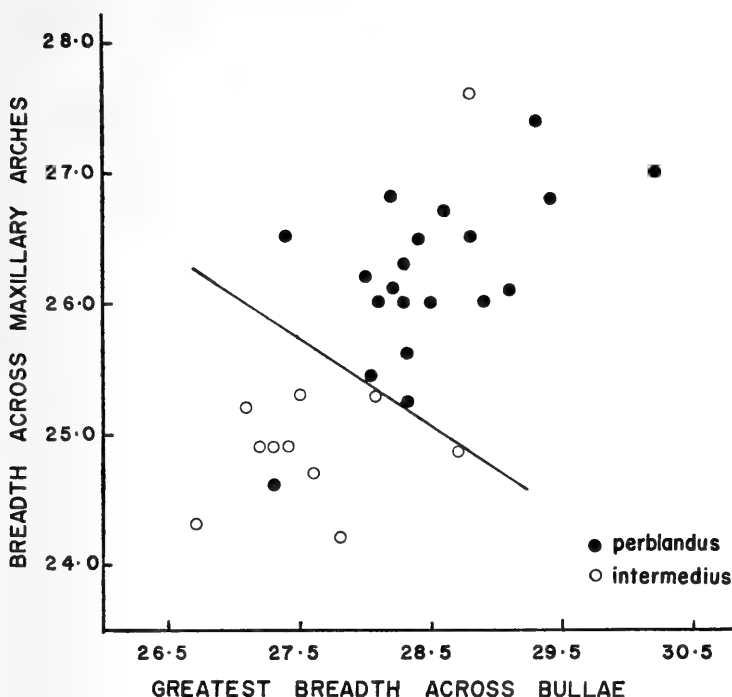


FIG. 1. Scatter diagram comparing *Dipodomys spectabilis intermedius* with *Dipodomys spectabilis perblandus* from Sonora, México, on the basis of breadth across the maxillary arches and greatest breadth across the bullae.

In a scatter diagram using breadth across the maxillary arches and greatest breadth across the bullae, it is possible to separate 91 percent of all adult *D. s. intermedius* from 95 percent of all adult Sonoran *D. s. perblandus* (Fig. 1).

Detailed comparison with the larger *D. s. spectabilis* is not needed here since *D. s. intermedius* is removed geographically from *D. s. spectabilis*, and because specimens belonging to this latter subspecies are even larger than those of *D. s. perblandus*.

Measurements: Mean and extremes of seven specimens from the type-locality, in mm, are: Total length, 325.0⁶ (314.0 to 330.0); tail length, 184.9 (174.0 to 195.0); length of white tip of tail, 20.0 (13.0 to 25.0); hind foot length, 47.6 (46.0 to 49.0); body length, 137.3 (130.0 to 146.0); greatest length of skull, 43.0⁵ (42.1 to 44.2); basal length, 31.0⁴ (30.5 to 31.8); length of nasals, 15.7 (15.2 to 16.8); greatest breadth across bullae, 27.7 (27.2 to 28.7); rostral width, 4.3 (4.1 to 4.4); bul-
lar depth, 14.4 (14.2 to 15.2); alveolar length of maxillary tooth row,

5.9 (5.3 to 6.3); least width of supraoccipital, 1.7⁵ (1.4 to 2.2); breadth across exoccipitals, 13.1⁴ (12.7 to 13.4); mandibular length, 17.9 (17.3 to 18.5); weight (grams), 98.8 (94.9 to 105.7).

Remarks: *Dipodomys spectabilis intermedius* is a small, pinkish buff-sided subspecies, with a short white tip of the tail. It is closely related to *D. s. perblandus*. Inasmuch as the former subspecies is intermediate morphologically between *D. s. perblandus* and *D. s. nelsoni*, the name *intermedius* seems appropriate. *D. s. intermedius* does not represent the terminus of clinal variation within the range of measurements of *D. s. perblandus*.

Dipodomys spectabilis intermedius intergrades with *D. s. perblandus* in central Sonora. One adult from 5 mi. W Querobabi which is referred herein to *D. s. intermedius* has a wide interparietal, wide supraoccipital, and small round openings of the external auditory meatuses, similar to those of *D. s. perblandus*.

Variations within *D. s. intermedius* include the following: One of five adults from 45 mi. N Hermosillo has the breadth across the maxillary arches and the greatest breadth across the bullae slightly larger than the typical. In two of seven adults from 16.7 mi. SW Bámori, the least width of the supraoccipital approaches that of *D. s. perblandus*.

Specimens from 45 mi. N Hermosillo were found associated with grass and palo fierro or ironwood (*Olneya tesota*) and those from 16.7 mi. SW of Bámori were found associated with grass, creosote (*Larrea* sp.), and palo verde (*Cercidium* sp.). Similar habitat to that from which specimens of *D. s. intermedius* have been taken is available in areas nearby, and future collecting will probably show that this subspecies has a wider geographic range. The limited number of specimens available from Sonora probably reflects the difficulty of access for collecting in much of this region.

Specimens examined: A total of 18 specimens from the following localities:

SONORA. 16.7 mi. SW Bámori, 1900± ft, 9 (MVZ); 5 mi. W Querobabi, 4 (KU); 45 mi. N Hermosillo, 2100± ft, 5 (MVZ).

The new subspecies of *Dipodomys deserti* is from the northwestern part of the range of the species and may be named and characterized as follows:

***Dipodomys deserti aquilus*, new subspecies**

Dipodomys deserti deserti: Hall, 1946:428 (part).

Holotype: Male, adult, skin and skull; No. 126411, Museum of Vertebrate Zoology, University of California; from 1½ mi. NW High Rock Ranch, T28N-R17E, Sec. 26, about 12 mi. SE Wendel, 4080 ft, Lassen Co., California; collected by C. S. Thaler, 21 July 1960, original number 1022.

Geographic distribution: East central Lassen Co., California, and northwestern Nevada.

More specifically, from the vicinities of Wendel and High Rock

Ranch, Lassen Co., California, E in Nevada to the vicinities of Nixon and Flanigan, Washoe Co., NE to the vicinity of Jungo, Humboldt Co., and SW to Adobe Flat and the vicinity of Toulon, Pershing Co. Limits of the range are not too well known especially in the northern and northwestern parts, and future collecting may reveal a wider range of this subspecies in these directions.

Diagnosis: A small subspecies of *Dipodomys deserti* averaging in total length about 323.5 mm; tail length in males about 193.4 mm; body length about 132.2 mm.

Color: Upper parts pale ochraceous-buff, heavily mixed with grayish and long blackish hairs; arietiform markings dusky; orbital ring blackish; plantar stripe brownish-black; dorsal tail stripe dark; ventral tail stripe dark and usually present; subterminal band at end of tail blackish.

Skull: Size small; greatest length averaging in males about 44.2 mm; breadth across maxillary arches narrow, measuring about 22.6 mm; nasals short, about 16.2 mm; greatest breadth across auditory bullae narrow, averaging in males about 29.5 mm; incisors slightly heavy. Also see measurements.

Comparisons: Compared with *D. d. deserti*, *Dipodomys deserti aquilus* is usually smaller in size especially in total length, tail length, and body length. Color of the upper parts, arietiform markings, plantar stripe, and dorsal tail stripe darker; ventral tail stripe usually present. Skull smaller particularly in greatest length, maxillary breadth, nasal length, and greatest breadth across the auditory bullae; the incisors are usually wider.

Measurements: Measurements, in mm, of two adult males and one adult female, respectively, from 21 miles west and 2 miles north of Lovelock, Pershing Co., Nevada, are: Total length, 325.0, 326.0, 328.0; tail length, 195.0, 191.0, 190.0; length of white tip of tail, 15.0, 18.0, 10.0; length of hind foot, 53.0, 51.0, 51.0; body length, 130.0, 135.0, 138.0; greatest length of skull, 44.3, 44.0, 44.3; length of nasals, 16.7, 16.1, 16.6; breadth across maxillary arches, 22.3, 22.6, 23.0; greatest breadth across bullae, 29.6, 29.4, 29.6; rostral width, 4.0, 4.1, 3.7; bullar depth, 14.8, 14.8, 14.8; alveolar length of maxillary tooth row, 5.6, 5.5, 6.0; breadth across exoccipitals, 12.3, 11.6, 12.3; mandibular length, 18.8, 17.9, 18.0.

Remarks: Typical *Dipodomys deserti aquilus* is characterized by its small external measurements, dark color, and small skull, especially in greatest length, maxillary breadth, nasal length, and greatest breadth across auditory bullae.

Dipodomys deserti aquilus intergrades with *D. d. deserti* in northwestern Nevada. Specimens from 3¼ mi. NNE Toulon and 3 mi. E Toulon, Pershing Co., are slightly larger in total length, tail length, and greatest length of skull, have more buffy color than typical *D. d. aquilus*. The adult from the former locality and one adult from the latter locality do not have ventral tail stripes, suggestive of *D. d. deserti*.

The adult specimen from Lassen Co., California, and the young

specimens from Washoe Co., Nevada, are much darker than the other specimens from northwestern Nevada, having blackish colored upper parts, dark arietiform markings, and dark, well-defined ventral tail stripes. Hall (1946:430) correctly noted, in the specimens then available to him, the darker coloration of the northwestern populations in Nevada and the presence of the dark ventral stripe in some specimens. Nevertheless, Hall (*ibid.*) seemingly overlooked the slight but constant differences in the size of several external and cranial parts between these populations and those to the southeast.

The name *aquilus* (meaning blackish in Latin) was chosen because of the blackish color of the specimens belonging to this subspecies.

Specimens examined: A total of 12 specimens from the following localities:

CALIFORNIA. LASSEN CO.: 1½ mi. NW High Rock Ranch, T28N-R17E, Sec. 26, 4080 ft., 1 (MVZ).

NEVADA. Washoe Co.: 4½ mi. N, 4½ mi. W Flanigan, 4000 ± ft, 2 (MVZ). Humboldt Co.: 8 mi. E, 1 mi. N Jungo, 4200 ft, 1 (MVZ). Pershing Co.: 21 mi. W, 2 mi. N Lovelock, 4000 ft, 3 (MVZ); 3¼ mi. NNE Toulon, 3900 ft, 1 (MVZ); 3 mi. E Toulon, 3900 ft, 4 (MVZ).

Additional records: NEVADA. Washoe Co.: 6 mi. W Flanigan, 2 (Univ. Puget Sound, MNH); 16 mi. E Wendel [California] (Hubbard, 1961: 135); 4½ mi. N and 2½ mi. W Nixon, 2 (Coll. Ira W. La Rivers and T. J. Trelease according to Hall, 1946:431).

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A SECOND SPECIES IN THE DIPLOPOD GENUS
CHOCTELLA (SPIROSTREPTIDA: CHOCTELLIDAE)¹

BY RICHARD L. HOFFMAN
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The remarkable milliped species *Choctella cumminsi*, type of a genus and family endemic in southeastern United States, but having its closest affinities with Neotropical families, was described nearly 50 years ago (Chamberlin, 1918) from specimens taken near Nashville, Tennessee. Subsequently no other material was found until 1950, when Leslie Hubricht collected two specimens in Grundy County, Tennessee, which stimulated the proposal of the family Choctellidae (Chamberlin and Hoffman, 1950).

During the past 14 years, Mr. Hubricht has collected *Choctella* at many localities in central Tennessee and adjacent northern Alabama, but all of the material proved to represent the type species. Recently, Mr. Hubricht sent in five specimens of an unusually distinctive second species which he collected in central Alabama.

For some time I have been preparing a monograph on the morphology, distribution, and systematic position of *Choctella*. However, since several years may elapse prior to publication, I think that advance description of the new form is desirable.

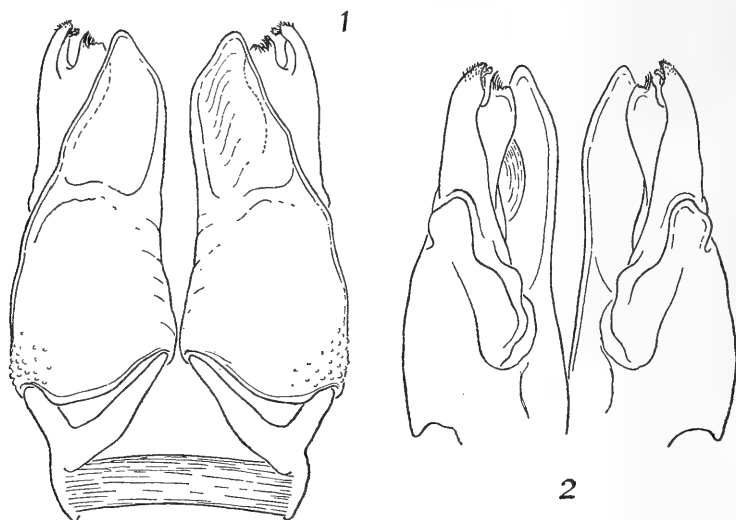
***Choctella hubrichti*, new species**

Figs. 1-3

Type specimens: Male holotype (U.S. Nat. Mus.), two male and two female paratypes (RLH), from wooded hillside, two miles southwest of Roebuck Plaza, Jefferson Co., Alabama, collected on 18 May 1963, by Leslie Hubricht.

Diagnosis: A small species of *Choctella* with the following characteristics: body diameter less than 3.5 mm in males, less than 4.0 mm in females; dorsum nearly black with a sharply defined, moniliform, median

¹ A contribution from studies supported by a grant (G-21519) from the National Science Foundation.



FIGS. 1, 2. *Choctella hubrichti*, n. sp., 1, gonopods of male holotype, anterior aspect. 2, the same, posterior aspect.

dorsal yellow stripe about one-half as wide as body diameter; telopodite of gonopods distally spiculate, with a small subterminal branch, and with a broad, laminate, distally lacinate lobe on the mesial side (Fig. 3).

Holotype: Male, about 34 mm in length, 3.2 mm in greatest diameter; body with 43 segments, the last three are legless.

Superficially the body appears dark brown, almost black, dorsally, with a broad yellow longitudinal band extending from middle of collum to tip of epiproct; legs and underparts lighter brown. Coloration in detail as follows:

Front of head light reddish-brown, becoming dark brown at labral and genal margins; a dark transverse interantennal band encloses a large oval light spot on each side just mesad to the antennae, and two pairs of much smaller spots near the median line. Epicranium blackish, profusely dotted with reddish-brown flecks; sides of head, mandibles, and gnathochilarium mostly yellowish-white; antennae dilute purplish-brown.

Collum dark brown laterally and along anterior and posterior margins, discally light reddish brown with a subtriangular mid-dorsal yellow spot on the caudal half, and a smaller squarish spot just behind the front margin. Body segments each with a broad, clear, transparent posterior edge (the posterior half of the metazonite); the preceding anterior half of the metazonite dark reddish brown. Dorsolateral half of mesozonite reddish brown with prominent black reticulation down to level of ozopores, below which dark brown like the adjoining metazonite; prozonites essentially concolorous with mesozonites. Each segment dor-

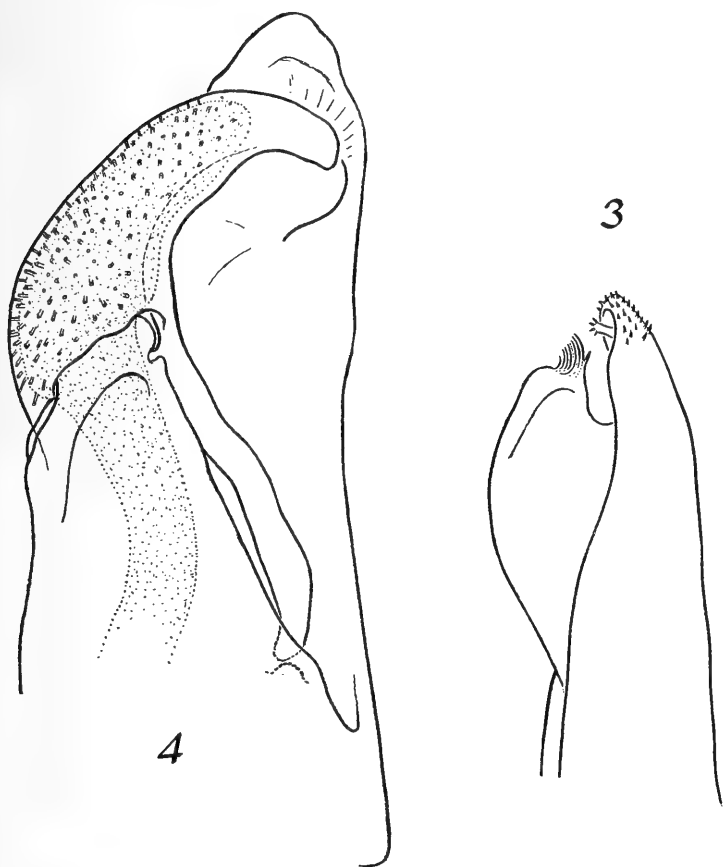


FIG. 3. *Choctella hubrichti*, distal half of telopodite of left gonopod of holotype, caudal aspect, enlarged. FIG. 4. *Choctella cumminsi*, coxite and telopodite of right gonopod, caudal aspect, drawn to same scale as Figs. 1 and 2.

sally with a transversely oval yellow spot, widest just anterior to transverse suture, and a second, smaller but broader, spot on the prozonite; these spots are only narrowly separated and create the effect of a continuous, moniliform, middorsal stripe. Terminal segment uniformly dark brown on the sides, middorsally and midventrally yellowish white. Paraprocts uniformly purplish-brown, narrowly margined with yellow.

Structural details essentially identical with those of *cumminsi* (to be described in full in a later publication). Metazonites prominently striated about two-thirds of the distance up to level of ozopores. On

segments 2-6, the 4th and 5th podomeres of the legs are provided with membranous ventral pads; on segments 8-10, the pads appear on the 3rd podomere; beginning on segment 11, the 2nd-5th podomeres are padded.

Gonopods basically similar to those of *cumminsi* in form of the parasterna and coxae, but the telopodites are distinctly different in structure (compare Figs. 3 and 4) in being terminally ornamented with numerous small spicules, and provided with (1) a small spiculate subterminal process, and (2) a large, broad, flat, distally fringed mesial lobe. The surface of the telopodite is much less distinctly perforated by openings from the internal gland than in *cumminsi*.

Paratypes: Structurally similar to holotype, the two males have 42 and 44 segments and are 3.4 and 3.3 mm in diameter respectively; the larger female has 44 segments and is 3.8 mm in diameter. Specimens of *cumminsi* likewise have 42-45 segments, but are much larger, the males greater than 4.0 mm in diameter, the females greater than 4.5 as a rule. In direct comparison, *cumminsi* appears at least twice as bulky as its smaller congener.

Remarks: *Choctella cumminsi* is likewise bicolored in life, but the dorsum tends to be reddish-orange in color, and there is less impression of a median stripe, the dorsal color diffusing laterally into the blackish lateral pigmentation. In both species, the lighter oval spots and areas are merely the external manifestation of muscle attachments on the inner segmental surfaces. The outermost layer of the body wall is essentially clear and transparent, and in fact the entire posterior half of the metazonites is not underlain by a black layer of pigmentation.

Roeback Plaza is a small settlement located about half-way between Trussville and Birmingham, in the northeastern quadrant of Jefferson County. This locality is on the eastern side of Red Mountain, which extends southward through Birmingham itself.

All of the many known localities for *C. cumminsi* are, with one exception, restricted to the north side of the Tennessee River (the species has been collected once about a mile south of Guntersville, in Marshall Co., Alabama). At the present time, there is a gap of about 50 miles between the ranges of *cumminsi* and *hubrichti*, which is perhaps more illusory than real. Yet it must be emphasized that Mr. Hubricht has collected millipeds in northern Alabama very assiduously for nearly 15 years, before happening to discover the singular little choctellid which I am pleased to name in his honor. Either *C. hubrichti* is scarce in the sense of having a fragmentary relict status, or else occupies a biotope quite different from that of *cumminsi* further north.

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PROCEEDINGS
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NOTES ON NORTH AMERICAN SHORE FLIES
OF THE SUBFAMILY PARYDRINAE
(DIPTERA: EPHYDRIDAE)

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The North American shore flies for the most part have received excellent taxonomic treatment through the revisions of Cresson (Trans. Amer. Ent. Soc. 68: 101-128, 1942; 70: 159-180, 1944; 72: 227-240, 1946; 74: 225-260, 1949) and Sturtevant and Wheeler (idem. 79: 151-257, 1954). Our poorest understanding is in the subfamily Parydrinae, and particularly the genus *Parydra* Stenhammar (reviewed as *Napaea* Robineau-Desvoidy by Sturtevant and Wheeler). The purpose of this paper is to discuss the correct generic affiliations of two species not studied by Sturtevant and Wheeler; *metallica* Cole, for which a new genus is erected, and *yukonensis* (Cresson), which is synonymized with the Holarctic *Eutaenionotum guttipennis* (Stenhammar); and to describe a second species in the subgenus *Callinapaea* Sturtevant and Wheeler.

Rhinonapaea, new genus

Head very short and broad; frons at level of ocellars measuring 1.5 times as wide as length from antenna bases to level of verticals; two pairs of very long diverging fronto-orbitals, subequal in length to the ocellars and inner and outer verticals. Face short, with very strong, noselike median hump, the nose broader and not so prominent between antenna bases, most prominent and sharper about midway between antennae and epistomal margin; clypeus very prominently exposed on anterior margin of mouth cavity; one pair of very strong facials, subequal in length to ocellars, plus several fine hairs posteriorly on cheeks; the latter broad and convex, measuring vertically about one-third of eye height. Antenna with third segment exceptionally large, slightly broader than long, with finely pubescent arista which is rather stout toward base.

Thorax only slightly convex above; no humerals, two pairs of strong notopleurals, one pair of strong supra-alars, one pair of strong intra-alars; four widely separated rows of sparse discal setulae comprising the acrostichal and dorsocentral series, mesonotum also with sparse setulae laterally. Scutellum only slightly convex; caudal margin bluntly rounded, without tubercles; two subequal pairs of marginal scutellars. Pleuron with one mesopleural, one sternopleural, bare of setulae except a few fine ones dorsally on mesopleuron. Legs normal; femora moderately slender, without armature; claws very slender and curved. Wing uniformly infuscated, without pale or dark maculation; anterior crossvein located directly behind tip of first vein; second vein straight and moderately long, slightly upcurved at tip, costal ratio (length of second section divided by length of third section) 3.7; third vein and distal section of fourth subparallel to wing margin; costa ending at tip of fourth vein; fourth vein index (length of apical section divided by length of preapical section) 1.25; fifth vein slightly bowed posteriorly toward tip of discal cell, last section incomplete, extending only halfway from junction with posterior crossvein to wing margin.

Abdomen markedly flattened above on proximal half, with rather sharp lateral margins, becoming distinctly convex above on fifth segment in male. Abdominal terga without coarse sculpturing, but uniformly micropunctate and metallic in appearance, with only sparse fine hairs; lengths of terga II-V in proportion of 13-16-17-17 in male, II-VI as 13-16-17-14-5 in female; fifth tergum of male rounded caudad in dorsal view; male with a pair of very large genital lamellae as long as fifth tergum, each plate twice as long as basal breadth, tapering to bluntly rounded anterior point with narrow polished lateral margin in ventral view, lamellae without hairs or spines.

Type-species: Parydra metallica Cole, by present designation, the only known species.

Notes: This genus is closest to the *Parydra* subgenus *Chaetoapnaea* Hendel. That subgenus is a somewhat heterogeneous assemblage of species having the face much more evenly convex than in *Rhinonapaea*, without noticeable nose or carina, the antennae much smaller, the frons usually longer with from one to three strong fronto-orbitals, the clypeus not so prominently exposed; the scutellum more convex and often with caudal tubercles; the wing with the anterior crossvein usually located much beyond the tip of the first vein, the second vein usually not nearly so long, often undulating, its apical portion very variable from straight to abruptly bent subapically with a short appendage at the bend, the wing usually with faint hyaline spots near the darkened posterior crossvein; the abdomen usually much broader and more convex, more oval in dorsal profile with the male genital lamellae much shorter and not nearly so prominent.

Rhinonapaea metallica (Cole), new combination

Parydra metallica Cole, 1921, Proc. California Acad. Sci., 4 (11): 176 (male; Pribilof Islands; Fig. head).—Malloch, 1923, N. Amer. Fauna, 46: 222 (Pribilof Islands; Fig. head).

Napaea (*Chaetoapnaea*) *metallica* (Cole); Cresson, 1949, Trans. Amer. Ent. Soc., 74: 234 (Pribilof Islands).

Napaea metallica (Cole); Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc., 79: 220 (notes).

New Records: MANITOBA: Churchill, 15 June 1930, O. Bryant, 1 female (U.S. Nat. Mus.). NORTHWEST TERRITORY: Aklavik, 10 Aug. 1931, O. Bryant, 2 females (USNM). Eskimo Point, 29 June 1950, G. G. DiLabio, 1 male (Canadian Nat. Coll.). Kidluit Bay, Richards Is., 27 July 1948, J. R. Vockeroth, 1 male (CNC). Padley, 30 June 1950, R. A. Henniger, 1 female (CNC). Salmita Mines, 64°05'N, 111°15'W, 16 Aug. 1953, J. G. Chillcott, 1 female (CNC). Spence Bay, 23 June 1951, J. G. Chillcott, 1 female (CNC).

Genus *Eutaenionotum* Oldenberg

Eutaenionotum Oldenberg, 1923, Deutsch. Ent. Ztschr., 1923: 315
Type-species, *olivaceum* Oldenberg, monobasic.

Eutaeniotum, lapsus, Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc., 79: 205.

Eutaenionotum guttipennis (Stenhammar)

Notiphila guttipennis Stenhammar, 1844, Handl. K. Svensk Vet. Akad., 1843: 212 (Lapland; male; described in Section 2 (*Telmatoxia*) of *Notiphila*).

Pelina guttipennis (Stenhammar), Becker, 1896, Berlin Ent. Ztschr., 41: 199.—Becker, 1926, Fliegen Pal. Reg., 10: 62.

Eutaenionotum guttipennis (Stenhammar), Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc. 79: 205 (New Hampshire; as *Eutaeniotum* sic!).

Napaea (*Chaetoapnaea*) *yukonensis* Cresson, 1949 (New Synonymy) Trans. Amer. Ent. Soc. 74: 234 (male; Alaska).

New Records: ALASKA: Golovin, 19 Aug. 1929, 1 female (U.S. Nat. Mus.). Mt. McKinley Nat. Park, 1931, F. W. Morand, 1 female (USNM). QUEBEC: Great Whale river, 5 Sept. 1949, J. R. Vockeroth, 1 male (Canadian Nat. Coll.). Hemmingford, 5 May 1950, J. B. Maltais, 1 female (CNC). SWEDEN: Abisko, Lapland, 15 June 1951, J. R. Vockeroth, 1 male, 1 female (CNC).

Notes: A close comparison of the descriptions of *guttipennis* by Stenhammar, Becker, and Sturtevant and Wheeler, with the type of *yukonensis* and with Lapland and North American specimens convinces

me of their synonymy. *E. guttipennis* is very easily recognized by the absence of fronto-orbital bristles, clypeus visible in profile view, head with velvety black lateral frontal vittae, wing with long second vein, the costal index 4.0, anterior crossvein placed directly under tip of first vein, and three faint, pale wing spots, these characters together differentiating the genus *Eutaenionotum* from *Hyadina* Haliday, *Parydra* Stenhammar, and *Pelina* Haliday. The only other known species of *Eutaenionotum* is the type-species *olivaceum* Oldenberg from Germany, which apparently differs mainly in coloration, with yellowish dusting on the olive-colored face, and mesonotum brownish olive green with yellowish vittae. In *guttipennis* the face is dark brown with faint grayish-white dusting and the mesonotum is brownish black with four grayish brown vittae. It is very likely that these color differences are of less than specific, if any, taxonomic importance.

Genus *Parydra*, Subgenus *Callinapaea* Sturtevant and Wheeler

Napaea, subgenus *Callinapaea* Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc., 79: 220. Type-species, *Napaea aldrichi* Sturtevant and Wheeler, original designation.

***Parydra* (*Callinapaea*) *aldrichi* (Sturtevant and Wheeler),
new combination**

Napaea (*Callinapaea*) *aldrichi* Sturtevant and Wheeler, 1954, Trans. Amer. Ent. Soc., 79: 220 (male, female; California, Washington, Iowa).

New records: ALASKA: Matanuska, 5 June 1944, J. C. Chamberlain, 1 female (U.S. Nat. Mus.). ALBERTA: Elkwater, 49°42'N, 110°16'W, 29 May 1955, J. R. Vockeroth, 1 female (Canadian Nat. Coll.). CALIFORNIA: Forest Home, 25 May 1935, A. L. Melander, 1 female (USNM). IDAHO: Waha, 30 May 1924, A. L. Melander, 1 male (USNM). WASHINGTON: Lake Crescent, Fairholm, 26 July 1917, A. L. Melander, 1 male (USNM). Mt. Constitution, 17 May 1910, 1 female (USNM).

Notes: This species, which is the type of the subgenus *Callinapaea*, approaches in many characters the genus *Eutaenionotum*: the flat face, with faint median carina dorsally; the reduction of the fronto-orbitals to a weak posterior bristle and a row of tiny setae in front; one pair of strong intra-alars with no true dorsocentrals; the costa extending to fourth vein, anterior crossvein located directly behind tip of first vein, and the second vein long, the costal index 5.0. In *Callinapaea* the clypeus is entirely hidden in the oral cavity and in this species the wings are strikingly maculate with numerous definite brown spots in the cells. Not mentioned in the original description is a striking character of the male, a definite posteroventral comb of about 8 short, sharp, black spines on the mid-femur.

Parydra (Callinapaea) laurentiana, new species

A dull, grayish-brown species with grayish dusted face and subshining blackish abdomen; wing pale brown with two faint pale spots next to posterior crossvein.

Male: Wing 2.23 mm long. Frons dull brown pollinose, ocellar triangle blackish; face, cheeks, and posterior orbits dark gray with gray pollen; antennae and palpi brownish black. One pair of strong facials, as long as arista, and behind each a row of 2-3 minute hairs along facial groove; one weak hair on each cheek; one pair of moderately strong, diverging fronto-orbitals, no anterior setae evident; ocellars, inner and outer verticals strong.

Thorax brownish with heavy grayish-brown pollen, mesonotum with a pair of broad, submedian, longitudinal, dark-brown vittae; scutellum with flat disc, gray on flat portion, brown on sides. No humerals; two notopleurals, the anterior one only moderately strong; one pair of strong intra-alars, a pair of strong supra-alars; acrostichal setae extending anteriorly in two definite rows between the intra-alars, setae scattered sparsely laterad of dorsocentral series; two pairs of scutellars, the anterior pair half as long as apical pair.

Legs brownish black, without strong setae; no posteroventral armature on mid-femur. Wings pale brown infuscated, the veins darker brown; two very faint, paler spots, one on each side of posterior crossvein. Anterior crossvein located directly behind end of first vein; second vein long, costal index 5.0; fourth vein index 1.4. Halteres yellowish.

Abdomen brownish black, shining in lateral view, dull brown anteriorly in dorsal view, especially on second tergum; fourth tergum slightly longer than third, fifth shorter than fourth, triangular in dorsal profile; genitalia hidden.

Types: Holotype male, St. Louis, Quebec, 15 Aug. 1918, J. Ouellet, deposited in Canadian National Collection, Ottawa. Paratype, 1 male, same data, in U.S. National Museum.

Notes: This species is a typical *Callinapaea* structurally, but is readily distinguished from *aldrichi*, the only other known species of the subgenus, by its faintly marked wings, more typical of other *Parydra* or of *Eutaenionotum*.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

SUPPLEMENTARY NOTES ON NORTH AMERICAN
AND MEXICAN SPECIES OF *DECODES* AND
ARGYROTAENIA, WITH DESCRIPTIONS
OF NEW SPECIES
(LEPIDOPTERA: TORTRICIDAE)

BY JERRY A. POWELL
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Subsequent to completion of my manuscript in June, 1962, on California members of *Decodes* and *Argyrotaenia*, biological data and material representing an undescribed species in each genus in California have accumulated. These data are presented here as a supplement to my earlier treatment (Powell, 1964). In addition, since our recent discussions concerning species of these genera (Powell, 1960; Obraztsov and Powell, 1961; Obraztsov, 1961) a number of records have accumulated which provide significant data on variation or geographical distribution.

Males of many species of both these genera have oblong eyes relative to the round eye of the female, a fact not noted in my earlier descriptions. Thus males have a slightly greater "vertical eye diameter" than do females (usually about 10% greater), and ratios given previously comparing eye diameter with length of the labial palpus refer to males only. This sexual dimorphism does not occur in all Tortricinae (e.g., *Acleris*, where male and female eye shape and size appear to be comparable), but it may be common to most Cnephasiini and Archipini.

Decodes fragarianus (Busck)

Tortricodes fragariana Busck, 1919, Proc. Ent. Soc. Washington, 21:52.

Decodes fragarianus, Obraztsov and Powell, 1961, Jour. Lepid. Soc., 14:115, figs. (1960) (taxon., synonym.); Powell, 1964, U. California Publ. Ent., 32:133, figs. (taxon., lit., biol.).

As pointed out to me by J. G. Franclemont, Cornell University, Ithaca, the synonymy of this species should be corrected by transferral of the Forbes (1924) report of *fragarianus* in New York, to *D. basiplaganus*, since the former is not known east of the Rocky Mountains.

A male and female from Millard County, Utah (9 mi. E Oak City, IX-2-63, D. C. & K. A. Rentz) have a very pale ground color in comparison to California specimens. The Utah moths have the basal band considerably darker than any other marking of the wing and superficially resemble *D. montanus* more than do any other *fragarianus* I have seen. In male genitalia the Utah specimen differs by having a somewhat more tapered fultura superior (JAP prep. no. 1586), approaching the form shown by *D. basiplaganus*. The distinctive female genitalia, aedeagus, and small socii characteristic of *fragarianus* are shown by the Utah specimens, however.

A series from Inverness, Marin Co., California (10 ♂ ♂, 1 ♀ VIII-19 to IX-23-62, C. A. Toschi) exhibits a paler forewing ground color than most California examples, but the basal band is not darker than the median one. As a result, the whitish submedian band and dorsal area are the most distinctive markings and a resemblance to *D. lundgreni*, described below, is shown.

In discussion of the biology of *D. fragarianus* (Powell, 1964) mention was made of three males taken mid-June to mid-July, 1960, at El Cerrito and Berkeley in the urban east bay area of the San Francisco Bay region. Since the remainder of more than 400 specimens examined from low elevation spots in California were taken or reared between mid-August and early November, it was suggested that unnatural stimuli due to effects of man may have been of significance in the early emergences. During a warm spell in late June, 1962, however, a series of females was taken at a blacklight in the same area (Piedmont Pines, NE Oakland, 1 ♂, 7 ♀ ♀ VI-19 to VII-1-62, P. D. Hurd, Jr.). Several of the females retained dirt in the papillae anales, indicating that oviposition had occurred. Although it is still possible that watering of lawns under oaks or other effects of urbanization may be the causal agent of these early flights, the present record suggests that colonies in given years may eliminate much of the pupal aestivation diapause. Whether egg diapause could withstand the prolonged period of dryness (heat is not necessarily a factor in this region) is not known.

One additional record regarding pupation site is noteworthy. In August, 1962, J. A. Chemsak, University of California, Berkeley, reared a male of *D. fragarianus* from logs of *Quercus agrifolia* which had been caged for studies on cerambycids. The moth emerged August 14 from material which had been cut about the end of July from more than ten feet above the ground on a living tree. The branch piece was caged the day following cutting, and since pupation is presumably completed by May, the larva must have pupated in the rough bark. Both laboratory and field evidence indicated that the normal pupation site is in the soil (Powell, 1964), and no *Decodes* cocoons were discovered during

subsequent extensive examination of *Q. agrifolia* bark on trees in San Francisco and Berkeley (Powell, 1963).

Decodes basiplaganus (Walsingham)

Sciaphila basiplagana Walsingham, 1879, Illus. Typ. Spec. Lep. Het. Brit. Mus., 4:23, Fig.

Tortrix basiplagana, Engel, 1908, Ann. Carnegie Mus., 5:117.

Decodes basiplaganus, Obratzov & Powell, 1961, Jour. Lepid. Soc., 14:116 (1960), Figs. (taxon., synon.); Powell, 1964, U. California Publ. Ent., 32:137, Figs. (taxon., lit.).

Tortricodes fragariana, Forbes (not Busck, 1919), 1924, Mem. Cornell Univ. Agr. Exp. Sta., 68:488.

Through the efforts of the late H. M. Bower, Wausau, Wisconsin, I have been able to study a series of *D. basiplaganus* from north central Wisconsin (Lake Katherine, Oneida Co., 50 ♂♂, 34 ♀♀ VIII-11 to IX-8-61). In addition to representing a northern record for the species, the series is unique in that females consistently show an elongate signum (5 preparations examined), which is about five to seven times as long as its greatest width, or relatively about half as long as that shown in the *johnstoni* group. This is the only known example in the genus where the signum exhibits appreciable interpopulational variation. Superficially the Wisconsin moths resemble those from other areas, being a little darker than the few *D. basiplaganus* seen from California.

***Decodes lundgreni* Powell, new species**

A moderately large *Decodes*, with narrow forewings having a conspicuous outer costal triangle that is particularly dark in the female.

Holotype male: Length of forewing 10.1 mm. *Head*: Labial palpus small, appressed scaled; second segment about 0.8 times as long as vertical eye diameter, nearly straight, not expanded distally; third segment about one-half as long as second, little obscured by scaling of second; dark gray, the scales narrowly white tipped. Antenna scaled dorsally, banded, only inconspicuously paler. Tufts of crown and vertex compact, dense, the scales conspicuously white at tips. *Thorax*: Dorsal scaling concolorous with head, tegula whitish at tip; metanotal brushes rather sparse, not concealing scutellum, latter unscaled. Underside shining whitish; pro- and mesothoracic legs dark gray exteriorly excepting whitish tibial and tarsal bands; metathoracic leg dirty whitish except tibial spurs and tarsi at bases dark. *Forewing*: Length about 3.1 times width; costa evenly curved from base to apex, latter acute, termen strongly angled back. Ground color pale whitish gray, marked by rather distinct dark gray as follows: a transverse band at basal one-fifth indicated by a triangular spot on costa and a small, irregular blotch at cubital fold; a large triangular blotch on costa, its inner side distinct, from costa before middle nearly to dorsal edge of cell at middle of wing, outer side less distinct, towards costa before apex; blending with apical infuscation, lat-

ter terminated by a distinct vertical mark before termen below apex; costa in triangle with three or four darker marks; a small mark on dorsum just before tornus. Underside dark gray, costa slightly paler with distal dark marks of upperside reproduced. *Hindwing*: Slightly broader than forewing, apex rather acute, termen concave and strongly angled back, tornus scarcely discernible. Pale gray, fringe paler. Underside pale, mottled with grayish, the veins darker. *Abdomen*: Gray, caudal segmental bands and genital tuft dirty whitish. Genitalia as in Fig. 1 (drawn from paratopotypes, JAP prep. nos. 1557, 1560: aedeagus; four preparations examined); socii moderately elongate, gnathos rather short; sclerotized flap of fultura superior narrow, evenly curved, U-shaped; sacculus narrow, its tip slightly free.

Allotype female: Length of forewing 9.2 mm. Similar to male, differing as follows: second segment of labial palpus about 0.9–1.0 times eye diameter. Forewing pattern with markings less distinctly margined but darker and more conspicuous, ground color somewhat more infuscated with darker scales. Abdomen uniform dirty whitish; lateroventral tufts of eighth segment slightly darker, reflecting purplish. Genitalia as in Fig. 3 (drawn from paratopotype, JAP prep. no. 1589, three preparations examined); sterigma with an elongate, tapered plate of antrum; signum elongate, broadened, rasp-like.

Holotype male and allotype female: Twain Harte, Tuolumne Co., California, 4 October 1963 (M. Lundgren) deposited in the California Academy of Sciences, San Francisco. Paratypes: 52♂♂, 14♀♀, same data, except IX-27 to X-18-63, deposited in the American Museum of Natural History, British Museum, California Academy of Sciences, California Insect Survey, and U. S. National Museum.

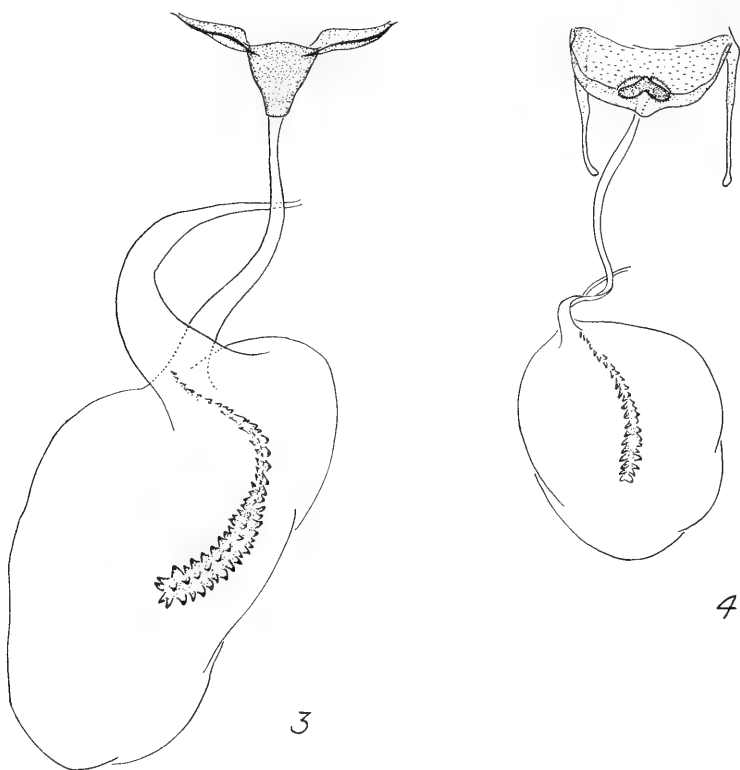
Range of length of forewing in paratypes: males, 8.9 to 10.4 mm; females 8.5 to 9.3 mm. All are essentially similar to the above description, the sexual dimorphism being consistent. Most of the specimens are somewhat worn and consequently show the color pattern less well defined than on the holo- and allotype. The whitish scaling seems easily lost; and it is mostly lacking from worn individuals, which show only the darkest areas of the pattern. Eighteen additional specimens (16♂♂, 2♀♀) with the same data were examined but not designated as paratypes; they are so worn that no pattern is evident. Several males show a greater development of dark gray in the basal area particularly as an outwardly pointed extension along the cubital fold, so that a pale submedian band comparable to that of other *Decodes* is defined between the basal area and costal triangle. Some of these have the costal triangle infused with pale scales except on its inner margin. In all, however, the triangle is the most conspicuous mark of the wing, whereas in *D. fragarianus*, *basiplaganus*, and *montanus*, the basal dark band or pale submedian band are more conspicuous.

The narrow forewing and elongate signum are characters *D. lundgreni* shares with the *johnstoni* group. However, in male genitalia the species is a member of the *fragarianus* group and is most similar to *D. montanus*,

differing by the small sclerotized plate of the fultura superior. The female genitalia are distinguished by the narrow, tapering plate of antrum and the elongate signum.



FIGS. 1, 2, male genitalia ventral aspect, valvae spread; aedoeagus removed, shown lateral aspect. 1, *Decodes lundgreni* Powell; 2, *Argyrotaenia lignitaenia* Powell.



FIGS. 3, 4, female genitalia, structures associated with eighth abdominal segment, ventral aspect. 3, *Decodes lundgreni* Powell; 4, *D. australis* Powell.

The series was taken at a 15-watt fluorescent blacklight in the absence of any other species of *Decodes*. The type locality is situated on the west slope of the Sierra Nevada at about 3600 feet elevation. The single specimen representing a record for *D. fragarianus* in the Sierra Nevada (Powell, 1964) from Silver Lake, Amador County (7200') has been reexamined and confirmed as that species. I take pleasure in naming this species for Milford Lundgren, of Twain Harte, who has collected many rare and little known Microlepidoptera in my interest during the past several years.

***Decodes australis* Powell, new species**

A moderately small *Decodes* with pale forewings showing a distinct dark basal band and median spot, from central Mexico.

Holotype female: Length of forewing 7.6 mm. *Head*: Labial palpus length about 0.8 times vertical eye diameter, third segment about one-half the length of second; dark gray exteriorly, whitish interiorly. Antenna scaling pale, distinctly banded with whitish dorsally to beyond basal half. Scale tufts compact, of crown rather decumbent, white; of front nearly appressed, brownish with white tips; of occipital area spreading, erect, mostly whitish with some brownish scales interspersed. *Thorax*: Dorsal scaling brownish gray, the scale tips white, tegulae apices broadly whitish; laterocaudal tufts of metanotum reduced, white, not obscuring scutellum, latter unscaled. Underside scaling shining whitish; pro- and mesothoracic legs banded with dark brownish gray, metathoracic leg whitish. *Forewing*: Length about 2.7 times width; costa gently curved from base to apex, latter pointed, termen not strongly angled back, dorsum slightly concave before tornus. Ground color pale whitish gray, somewhat infused with brownish gray especially along margins in outer half and sparsely irrorate with blackish scales; markings distinct, dark brownish gray, as follows: a basal spot below costa, a band at basal one-fourth, bent downward in cell, becoming indistinct below cubital fold (holotype badly worn in anal area); a vertical, oblong spot at about middle of wing, from within cell towards dorsum, becoming indistinct before latter. Fringe pale grayish. Underside gray, basal area whitish. *Hindwing*: About as broad as forewing; uniform dark gray, fringe paler. Underside whitish, infused with grayish between veins, more heavily so in basal half and in costal area. *Abdomen*: Treated in caustic solution and deposited in glycerine. Genitalia as in Fig. 4 (drawn from holotype, JAP prep. no. 1097, one preparation examined); sterigma heavily sclerotized but short, without an elongate plate of antrum; ductus without sclerotized areas; signum a rasp-like band.

Holotype female: Ridge northwest of Jocoque Dam, Aguascalientes, Mexico, 19 August 1960 (P. H. Arnaud, Jr., E. S. Ross, D. C. Rentz); unique, deposited in the California Academy of Sciences.

The broad forewing of *australis* is similar to the *fragarianus* group, but without male genitalia characters available, conclusions as to relationships of the species cannot be made. The locality is some 600 miles to the south of previous *Decodes* records.

Argyrotaenia montezumae montezumae (Walsingham)

Tortrix montezumae Walsingham, 1914, Biol. Centr. Amer., Lep. Het., 4:280.

Argyrotaenia montezumae montezumae, Obraztsov, 1961, Amer. Mus. Novitates, 2048: 2, Figs. (synon.).

This species has been recorded from Honduras, Guatemala, and in Mexico from Veracruz, Puebla, and Mexico, D.F. In his recent treatment of some Mexican species Obraztsov (1961) illustrated some of the variation which males of *montezumae* exhibit, and he recognized the

dissimilar *A. impositana* (Walsingham) as the female of *montezumae*. Provided this interpretation is correct, the sexual dimorphism is comparable to that shown by *A. citrana* in California, and similarly, the females appear to be less variable than the males.

Several specimens in the California Insect Survey collection provide noteworthy Mexican records for *A. montezumae*, as follows.

VERACRUZ: 1 mi. W Fortin, 1 ♂ VII-2-62 (D. H. Janzen), a small (forewing length 6.8 mm) and distinctly marked specimen; Fortin de las Flores, 2 ♀ ♀ XII-25-63 (C. A. Toschi & M. J. Tauber), large (forewing length 8.9–9.4 mm) and typically indistinctly marked specimens. Obraztsov mentions that Mexican specimens taken in October, November, and December have the ground color "more yellowish" and the markings paler. Other records given by Walsingham and Obraztsov are for June, July, and August, but none of these moths is figured. The Fortin July male and December females have about the same shade of dark ochreous ground color.

ZACATECAS: 9 mi. S Fresnillo, 1 ♂, 1 ♀ VIII-20-56 (D. D. Linsdale). This locality is considerably north of known records for the nominate subspecies. The Fresnillo female resembles Veracruz specimens in size and color. However, the male is unlike both *A. m. montezumae* and the Arizona race, *A. m. huachuensis* Obraztsov. The Zacatecas male is large (forewing length 8.8 mm), although scarcely larger than the range given for *montezumae* by Walsingham. The forewing ground color is dark ochreous, with the markings ochreous-brown, well defined, but not strongly contrasting. The basal markings are obsolete: the median band is more uniformly parallel sided than in Veracruz and Puebla *montezumae*, only slightly indented by ground color in the cell. The genitalia are not distinguishable from Obraztsov's photograph (Figs. 6, 7) of a specimen from Puebla.

***Argyrotaenia lignitaenia* Powell, new species**

A reddish moth, resembling *A. niscana*, but larger, paler, and having the forewing markings less distinct.

Holotype male: Length of forewing 9.6 mm. *Head*: Labial palpus rather short, second segment about 1.2 times vertical eye diameter; third segment less than one-third the length of second; scaling rust brown exteriorly, darker at apex (one palpus lacking). (Antennae lacking.) Head tufts dense, red brown, median scales darker apically; (front denuded). *Thorax*: Dorsal scaling pale orange brown; lateroposterior tufts of metathorax whitish, short, not obscuring scutellum, latter with a few elongate, white scales. Underside scaling shining whitish; prothoracic leg blackish, meso- grayish, meta- whitish exteriorly. *Forewing*: Narrow, length about 2.9 times width; costa slightly bowed from base to middle, slightly concave beyond; apex acute, pointed, termen strongly angled back, straight. Ground color pale rust orange basally, becoming dark rust brown distally; basal half without distinct markings, irrorate with diffuse, pale spots, a pale costal area at one-third; a rather

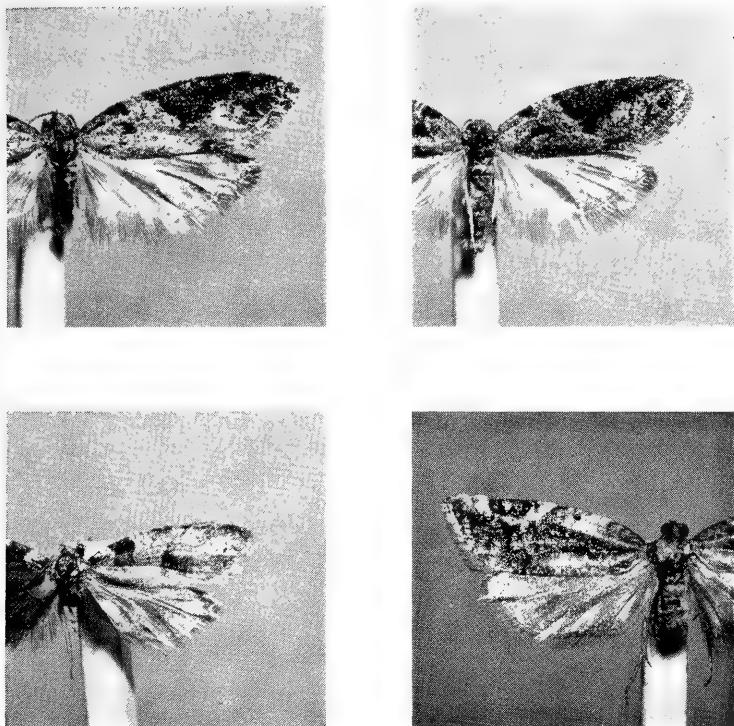


FIG. 5. Upper left, *Decodes lundgreni* Powell, holotype male; upper right, *D. lundgreni*, allotype female. Lower left, *D. australis* Powell, holotype female; lower right, *Argyrotaenia lignitaenia* Powell, holotype male.

distinct outwardly angulate band from just beyond mid-costa to end of cell, angled upward towards apex, meeting a pale triangular spot on costa before apex; some dark gray scales through end of cell preceding and following outer costal band, defining it outwardly. Fringe pale yellowish, orange at apex and tornus. Underside gray, faintly reflecting purplish, costa irregularly blotched with pale ochreous, especially on distal half; fringe pale ochreous. *Hindwing*: About as broad as forewing; costa nearly straight, slightly convex before apex, termen concave below apex, dorsum very slightly concave. Dorsal scaling pale gray; fringe whitish with gray band. Underside white, sparsely irrorate with grayish on apical half. *Abdomen*: Pale gray dorsally, shining white ventrally. Genitalia as in Fig. 2 (drawn from holotype JAP prep. no. 1092, one preparation examined); of *niscana-franciscana* group, socii small, gnathos

blunt, valvae somewhat pointed; uncus constricted in distal half; aedeagus tip beveled, simple.

Allotype female: Length of forewing 9.2 mm. Essentially as described for male, differing as follows: Labial palpus second segment about 1.5 times eye diameter, scaling pale rust orange exteriorly, whitish interiorly. Antenna less than one-half costa length, scaling dark gray ventrally, rust colored dorsally. Scaling of front not appressed, pale rust orange, becoming dark adjoining palpi. Forewing markings entirely indistinct, only suggested in basal half, distally not well defined. Genitalia not examined; presumably the same as the uniform *niscana-franciscana* group.

Holotype male and allotype female: Pinyon Flat [16 road miles southwest of Palm Desert], Riverside Co., California, 17 April 1962 (C. D. MacNeill) deposited in the California Academy of Sciences.

The close superficial resemblance of *A. lignitaenia* with *niscana*, which is associated with *Adenostoma fasciculatum* in cismontane southern California (Powell, 1964), suggests that the present species may be associated with *Adenostoma sparsifolium* which occurs along the east side of the San Jacinto Mountains and in other inland areas of southern California.

Argyrotaenia franciscana franciscana (Walsingham)

Lozotaenia franciscana Walsingham, 1879, Illus. Lep. Het. Brit. Mus., 4:13, Fig.

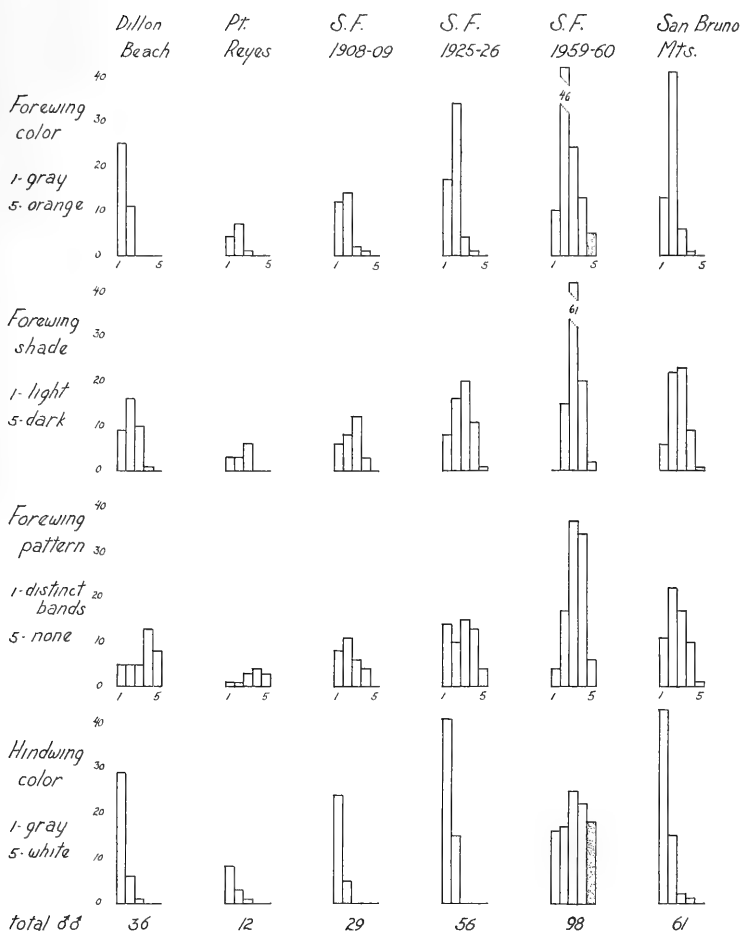
Argyrotaenia franciscana franciscana, Powell, 1964, U. California Publ. Ent., 32:196, Figs. (Taxon., synon., biol.).

Graph I illustrates some interpopulational variation in wing color exhibited by males of *A. f. franciscana* and shows change in the San Francisco population during a 50-year period. This evolution in phenotype was discussed and given as evidence that the typical *franciscana* once present on the sand dunes in western San Francisco (the type locality) has been affected by introduction of *Argyrotaenia citrana* as the area was urbanized (Powell, 1964).

Characteristics of depth and quality of wing color and pattern were subjectively estimated for each individual by comparison with extremes which were given numerical values of 1 and 5. Thus the graphs represent relative proportions of these characters, subject to sampling error. All the pinned specimens in the California Academy of Sciences and California Insect Survey collections were used. Females tend to be less distinctly marked and less variable, but specimens are not available in sufficient numbers to enable comparison.

Four recent California collections of this race are of interest:

1) Dillon Beach, Sonoma Co., 35 ♂♂, 1 ♀ V-18-63 (J. Powell). These were flushed and netted from beach dune bushes of *Lupinus chamissonis* on a foggy day. The series represents the only sizable ecotypic sample of the species to have been taken in the past 50 years. The forewing pattern is essentially similar to that shown by the small



Graph I. Distribution of individuals of *Argyrotaenia franciscana* (Wlshm.) according to wing color and pattern characteristics. Samples originate from four localities and from three areas at western San Francisco, spanning the urbanization period of that area. The shaded bars, exhibited only by recent collections at San Francisco, indicate forewing and hindwing colors typical of *Argyrotaenia citrana* (Fernald).

series taken at Pt. Reyes, Marin County in 1957-58, differing from populations further to the south by the prevalence of individuals with the pattern reduced or obsolete and by a general paler ground color (Graph I).

2) San Bruno Mts., San Mateo Co., 10 ♂♂, 1 ♀ V-3-63 (J. Powell).

The series was taken by beating *Baccharis pilularis* on an extremely windy day. Previous collections from the area were comprised entirely of males and were not associated with any host. The locality is one of a rich, highly mixed, coastal chaparral flora, including *Lupinus*, *Rhamnus*, *Scrophularia* and other possible foodplants of *A. franciscana*.

3) Morro Rock, San Luis Obispo Co., 2♂♂, 1♀ V-4-62 (J. Powell). The three individuals show such remarkable differences that no conclusion is apparent regarding the population there. One male is large (forewing length 8.3 mm) with the forewing pattern similar to typical *franciscana*. However, the forewing shape is broad, intermediate between *A. citrana* and *franciscana* (base-tornus: base-apex ratio = 1: 1.30). The hindwing color is also intermediate, gray on the basal half, becoming white toward the apex. The female is similar in size, forewing shape and hindwing color, but has considerable orange scaling on the forewings (which are badly worn).

The second male is completely different and may be characterized as follows: Forewing length 6.1 mm; base-tornus : base-apex ratio = 1 : 1.39; forewing ground color dark brownish gray, irrorate with black scales; markings whitish, distinctly margined but sprinkled with dark scales, a median band from before mid-costa to dorsum well before tornus, a partial band from beyond mid-costa towards tornus, meeting pale subterminal area, the two surrounding and defining the rounded outer costal spot; hindwing dark gray, fringe pale; abdomen blackish. The individual resembles only San Nicolas Island specimens of *A. franciscana insulana* Powell in material I have examined. The latter differ by a more chocolate brown rather than gray brown ground color and by having the pale markings somewhat more infused by ground color.

Morro Rock is a large rounded formation some 580 feet high, located at the entrance to Morro Bay several hundred yards from permanent ground of the mainland. It is now connected to the harbor area of the bay by what appears to be a man-made or recent sand spit. The rock bears a mantle of low, dense, coastal chaparral vegetation and could conceivably support an isolated population of *A. franciscana* which has been little or only very recently affected by *A. citrana* invading along an avenue of urbanization. Other records of the complex for the region (San Luis Obispo; Pismo Beach) are for *A. citrana* which is fairly typical of cismontane southern California (Powell, 1964).

4) Oso Flaco Lake, 5 mi. S Oceano, San Luis Obispo Co., 1♂ VIII-26-63 (J. Powell). The single specimen taken on a foggy day at this beach dune site somewhat resembles the *insulana*-like individual from Morro Rock. The Oso Flaco moth is smaller (forewing length 5.3 mm) with slightly paler ground color of both fore- and hindwings and with the markings distinct and somewhat more clearly whitish than on the Morro Rock example. The latter locality is about 30 miles north of Oso Flaco Lake. It will be interesting to see material in series from any spots in the area between Morro Bay and Point Concepción.

Argyrotaenia citrana (Fernald)

Tortrix citrana Fernald, 1889, Ent. Amer., 5:18.

Argyrotaenia citrana, Powell, 1964, U. California Publ. Ent., 32:203, Figs. (taxon., synon., biol.)

In my discussion of the geographical distribution of *citrana*, doubt was expressed that the species occupied as broad a range in California before the advent of civilization. It was pointed out that *citrana* is not known to have been native in northern California. There are no records for the northern half of the state prior to 1911, and the species has rarely been taken in natural habitats in the comparatively well collected central coast counties.

Several recent collections, however, tend to lessen, rather than confirm my doubts concerning the species' native occurrence at inland localities in this area. Although these for the most part do not represent natural sites or hosts, the populations exhibit phenotypes which are quite similar to that in cismontane southern California. The forewings are more or less uniform orange or orange-brown and the hindwings white, and the remarkable color and pattern variation exhibited by central coastal transition zone populations believed to represent areas affected by replacement of *A. franciscana* is not shown.

At Walnut Creek, Contra Costa County, only ten miles east of the coastal Berkeley Hills, moths taken April to October are of the typical *citrana* phenotype; those taken at lights in February usually have dark brownish forewings, a characteristic previously mentioned for the San Francisco Bay area populations. However, this may be a phenotypic response to winter conditions prevalent in the northern part of the state. Larvae collected at Walnut Creek in November and reared indoors produced adults of the bright orange early summer form.

Recent material from inland areas of the northern half of California which expresses typical *citrana* phenotype is as follows. Humboldt Co.: Miranda, 1 ♀ VIII-15-63, at light (J. Powell). Mendocino Co.: Ten Mile River, 3 ♂ ♂, 2 ♀ ♀ IX-5-62, r.f. *Eriophyllum staechadifolium*, emgd. X-(1-11)-62 (K. E. Frick). Contra Costa Co.: Walnut Creek (foot of Shell Ridge), 1 ♂ III-24-62, 1 ♂ IV-26-63, 1 ♀ V-25-61, 1 ♀ VI-18-62, 5 ♂ ♂, 3 ♀ ♀ VII-10 to VIII-20, '61-'62, 5 ♂ ♂ IX-18 to X-14, '61-'63, 1 ♂, 2 ♀ ♀ XI-24-63, r.f. *Pyracantha* berries, emgd. XII-14, 31-63, I-2-64 (JAP-63L3) (J. Powell). Alameda Co.: Oakland (back of Piedmont hills), 9 ♂ ♂, 6 ♀ ♀ V-14-62, r.f. *Cytisus scoparius*, emgd. VI-18 to VII-30-62 (K. E. Frick). Santa Cruz Co.: Lockhart Gulch, 4 mi. E Mt. Hermon, 1 ♂, 2 ♀ ♀ VII-11-61 (D. J. Burdick).

One additional native host plant can be added to the list of those utilized by *A. citrana*. Larvae were collected on *Photinia* (= *Heteromeles*) *arbutifolia* at Pt. Molate, Contra Costa Co., 27 December 1964. One female was reared, emerging January 27, and several adults of *A. citrana* were taken on the bushes 27 March 1964.

Argyrotaenia cupressae beyeria Powell, new status

Argyrotaenia beyeria Powell, 1960, Pan-Pac. Ent., 36: 85, Figs.; 1964, U. California Publ. Ent., 32:216, Figs. (taxon., biol.).

Study of additional material lends further evidence to my supposition (1964) that *beyeria* and *cupressae* should be considered as subspecies.

Another collection was made from *Cupressus goveniana* near Cuesta Pass, San Luis Obispo County (3♂♂, 1♀ IV-4-63, emgd. IV-25 to V-2-63, JAP 63D3). This population appears to be intermediate between the two named entities in forewing phenotype. As mentioned previously, the scattered occurrence of cypress in southern California probably resulted in considerable interpopulational diversity in *cupressae* and *beyeria* in the southern half of California.

A collection from Miranda, Humboldt Co. (3♂♂, 1♀ VIII-15-63, J. Powell) extends the known range of *cupressae* (sens. lat.) about 100 miles northward. The specimens are uniform in appearance and evidently represent a population which is nearly as distinct from *beyeria* as the latter appeared to be from *cupressae* when the two were originally described. The Miranda individuals are small (forewing length 7.8 to 8.5 mm) and have pale, indistinctly marked forewings, most closely resembling those from the Petaluma-Napa area in material previously examined. The hindwings are distinctly mottled with pale grayish on both upper and lower surfaces, whereas in other *beyeria* specimens the hindwings exhibit only a trace of grayish mottling or are completely white. The Humboldt Co. moths were taken at light in a redwood grove (the second such collection for the race) with no other conifers seen nearby. It now seems certain that *Sequoia* is utilized as a host in addition to *Cupressus*; and Taxodiaceae and Cupressaceae in general may be.

Argyrotaenia dorsalana dorsalana (Dyar), new status

Tortrix dorsalana Dyar, 1903, Proc. Ent. Soc. Washington, 5: 231.

Argyrotaenia dorsalana, Powell, 1964, U. California Publ. Ent., 32: 220, Figs. (taxon., synon.).

Specimens from Utah Co., Utah (Timpanogos Cave Nat. Mon., 4♂ VI-22-63, C. A. Toschi) have been examined. These are fairly typical for the species, resembling British Columbia and northern California material I have seen, with straw yellow forewings and moderately well-developed costal and dorsal markings (which are rust brown rather than dark). Utah Co. is located between Colorado and Utah areas previously cited for the rust orange forewing phenotype suggested as a Great Basin race (Powell, 1964). This may not be unreasonable, however, as Timpanogos Cave is in the Wasatch Range and this mountain chain may harbor typical *dorsalana* as an interdigitation into Great Basin areas of rust-orange forewing phenotype.

Argyrotaenia dorsalana lautana Powell, new status

Argyrotaenia lautana Powell, 1960, Pan-Pac. Ent., 36: 90, Figs; 1964, U. California Publ. Ent., 32: 222, Figs. (taxon.).

During the past year I was able to collect a few additional individuals of this little known moth (Mt. Palomar, San Diego Co., 2 ♂♂, 1 ♀ VII-18-63). The present specimens are larger (forewing length: ♂ 10.7 mm, ♀ 13.1 mm) but otherwise do not differ appreciably from the type lot. The forewing ground color of the Mt. Palomar series is slightly paler than that of the types but not as pale as that shown by the Greenhorn Mountains specimens mentioned in the original description. The female in the present collection lacks all markings except traces of the costal ones, and one male has somewhat more extensive markings than the holotype, and approaches the Greenhorn Mountains phenotype.

Study of recent material indicates that the parallel sided uncus cited for *lautana* in the original description is not a consistent character. In view of this and the forewing pattern variation shown at Mt. Palomar which further illustrates the similarity of *lautana* and *dorsalana*, it seems best to consider the two as subspecific components of a single species which is widely distributed both ecologically and geographically in the western Nearctic region.

Argyrotaenia dorsalana subspecies

One additional male specimen of the complex which probably represents an undescribed race in Mexico has been examined. The individual may be characterized as follows, but nomenclatorial subspecific designation is not reasonable on the basis of a single specimen.

Male: Length of forewing 7.6 mm. *Head*: Labial palpus short, second segment about equal in length to vertical eye diameter, third segment about one-third the length of second; scaling not greatly spreading, pale ochreous orange, brownish at tips; head tufts concolorous. *Forewing*: length about 2.6 times width, costa broadly bowed to middle, distinctly concave beyond, termen not strongly angled back, nearly straight. Ground color pale ochreous orange (somewhat worn), markings pale brownish as follows: costal dot at basal one-fifth; median band from just before mid costa to dorsum before tornus, narrow and distinct at costa, becoming broad and indistinct below cell, produced outwardly in cell; outer transverse band from apical concavity of costa to termen above tornus indicated by broad costal spot and a thin line from latter to termen. Some reddish orange scales along margin around apex to mid termen. Fringe with a distinct, dark basal band. *Hindwing*: white. *Genitalia*: similar to *A. dorsalana* (Powell, 1964: Fig. 46); uncus more elongate, about equal to length of tegumen; valva a little more pointed; caudal flap of sacculus slightly more produced, blunt-pointed sacculus tip spine more elongate; cornuti of vesica lacking from this individual.

Material examined: MEXICO: 60 mi. E Zamora, Michoacan, 1 ♂ VI-24-57 (J. A. Chemsak and B. J. Rannals).

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PROCEEDINGS
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THE GENUS *FREYCINETIA* (PANDANACEAE) IN
FIJI, TONGA, AND SAMOA

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This study may be considered supplementary to the recent treatment by Dr. L. M. Perry (*in Journ. Arn. Arb.*, 31: 208-213. 1950). There are no new taxa in collections received since Dr. Perry's publication, but various new records. The species are fully described here, but only those collections not previously cited are recorded. There are ten species admitted, the same number listed by Dr. Perry, whereas only eight were listed by Martelli in his latest treatment (1930. *Univ. California Publ. Bot.*, 12: 325-350); however, of these, two are here considered synonymous, *Freycinetia storckii* construed as to include *F. gillespiei* Martelli.

All of the Fijian Freycinetias belong to the typical section of the genus. This is interesting, as it places Fiji in the Polynesian area in the distribution of *Freycinetia*; the easternmost species of Sect. *Oligostigma* are *F. ponapensis* Martelli in Ponape and Kusaie, and the related *F. tessellata* of the Solomon Islands; and *F. reineckei* of Samoa. It may be that one or more species of Sect. *Oligostigma* remain to be discovered in Fiji, or in the New Hebrides, but it is unlikely that they would remain unknown to this time in the smaller, mostly more completely explored, and floristically poorer islands of Polynesia.

Key to *Freycinetia* of Fiji

1. Leaves pseudo-petiolate at base (narrowed and closely duplicate), abruptly acuminate and caudate at apex; raphe of seed broad (making up half of the seed in breadth). *F. caudata*
- 1'. Leaves not as above; seeds with a narrow raphe. 2
2. Pedicels scabrid or setulose at least in part; leaves mostly small (7-36 cm long). 3
- 2'. Pedicels smooth, glabrous. 8

3. Syncarps globose or subglobose to shortly oblong, broad, up to 1-2.5 cm diam. or 2.5 x 2 cm 4
- 3'. Syncarps cylindric, larger, to 8 cm long. 7
4. Leaves only 7-15 cm long, 3-20 mm broad. 5
- 4'. Leaves 16-37 cm long, mostly 6-13 mm broad. 6
5. Leaves mostly 1-2 cm broad; pedicels minutely and sparsely scabrid mainly on the angles. *F. grayana*
- 5'. Leaves mostly 3-8 mm broad; pedicels toward apex densely scabridulous all around. *F. vitiensis*
6. Syncarps suboblong, mostly 1.7-2.5 cm long; pedicels scabrid all round at apex. *F. graeffei*
- 6'. Syncarps mostly about 1.5 x 1 cm; pedicels scabrid on angles. *F. degeneri*
7. Syncarps 4-8 cm long, 2.5-4.5 cm diam.; berry pileus subrostrate, 3-4 mm long; pedicels densely scabrid all around at apex. *F. parksi*
- 7'. Syncarps 3-6 cm long, 2-3 cm diam.; berry pileus thicker and shorter, about 1.5-2.5 mm long; pedicels sparsely scabrid mostly on the angles. *F. storckii*
8. Leaves 30-67 cm long and mostly 2-3.8 cm broad. *F. milnei*
- 8'. Leaves mostly smaller, about 20-45 cm long and up to 2 cm broad. 9
9. Leaves only 25-30 cm long, mostly 1-1.5 cm broad, attenuate at apex, or sharply acute. *F. pritchardii*
- 9'. Leaves usually 20-45 cm long and 1.2-2 cm broad, attenuate-acuminate and subcaudate at apex. *F. intermedia*

Freycinetia caudata Hemsl. in Kew Bull., 1896: 167. 1896; Warb. in Pflanzennr., 3(IV.9): 38.1900; Martelli in Webbia, 3: 310. 1910, et in Univ. California Publ. Bot., 12: 327. 1930; Perry in Journ. Arn. Arb., 31: 209. 1950.

Scandent woody liane, older stems subterete, up to 2 cm in diameter, with a thin light brown bark; younger stems mostly 2-4 mm thick, obscurely trigonal, longitudinally somewhat rugulose when dry, the internodes distinct, usually 5-10 mm long; leaves subdistichous, thin-coriaceous, flattened, oblong-lanceolate or somewhat oblanceolate, mostly 10-33 cm long and 1.1-3.6 cm broad, attenuate-acuminate or mostly abruptly acuminate at apex, prolonged there into a short minutely denticulate cauda, very slightly attenuated toward the base from below the middle and near base abruptly duplicate into a pseudo-petiole about 1-5 cm long (similar to that of *F. petiolacea*); margins and costa entire except along the cauda; auricles membranous, scarious, fragile and soon caducous, entire, mostly 1-5 cm long, 3-5 mm broad, adnate and decurrent distally; inflorescences terminal, subtended by outer foliaceous and inner spathaceous pale yellow navicular ovate shortly caudate bracts,

all but the innermost slightly exceeding the spadices; staminate inflorescence of 3 spadices on a short common peduncle, each spadix on a slender glabrous pedicel up to 2 cm long, usually 15–35 mm long and 3–4 mm thick and composed of numerous densely crowded subsessile stamens surrounding minute pistillodes; filaments barely 0.1–0.2 mm long; anthers oblong, about 1 mm long; pistillodes spirally arranged, about 1.5 mm long; pistillate spadices cylindric, narrow, mostly (2–) 3–7 cm long and 5–10 mm thick, on slender glabrous pedicels mostly 1.5–2.5 cm long and 1–3 mm thick; berries at maturity 4–5 mm long and 1.5–2.5 mm thick, obclavate, the lower two-thirds or more succulent, the pileus about 1.5 mm long, rigid, penta-hexagonal, conic-acuminoid, the stigmatic areola on a very short columnar rostrum, truncate, with a pale smooth narrow ring surrounding the 2–4 (rarely 5) stigmas; pericarp membranous, translucent below, with scattered shining raphidophorous cells; seeds semiellipsoid to sublunulate, 0.6–0.8 mm long and 0.4–0.5 mm broad, with a broad white raphidophorous raphe occupying half or more of the seed; strophiole absent.

Type locality: Viti Levu: The type is Horne 592 (K); an unnumbered collection of Graeffe is also cited by Hemsley.

Distribution: Known from Viti Levu, Vanua Levu, and Ovalau; endemic to Fiji. Found as a climber in forests up to 1000 m altitude.

Local names: *wa me* (Viti Levu, Ovalau); *weilimbale* (Viti Levu); *me* (Viti Levu); *merikula* (Vanua Levu).

The following specimens are additional to those already listed by Perry. Only those at USNM are cited.

Viti Levu: Mba: Nandarivatu, valley of the Singatoka River (Gillespie 3167); Nandarivatu (Degener and Ordonex 13679). Serua: Hills between Waininggere and Waisese Creeks, between Ngaloa and Wainiyambia (Smith 9528); Hills west of Waivunu Creek, between Ngaloa and Korovou (Smith 9293). Namosi: Vicinity of Namuamua (Gillespie 3104); Vicinity of Nangarawai village (Gillespie 3211); Hills North of Wainavindrau Creek, between Korombasangasanga Range and Mt. Naitarandamu (Smith 8458). Tailevu: Hills east of Wainimbuka River, vicinity of Ndakuivuna (Smith 7153). Naitasiri: Tholo-i-Suva (Nand and Koroiveibau, Dept. Agric. Fiji, 10656).

Ovalau: U. S. Explor. Exped. 1838–42; Hills east of Lovoni valley (Smith 7684).

The cited specimens are quite uniform, although the Gillespie collections (nos. 3167 and 3211; also 3104) are characterized by extremely narrow leaves, the apices of which are almost attenuate rather than acuminate; but the characteristic pseudo-petiole aspect caused by the duplicate base of the blade is manifest, and the specimens differ in no other respects from more common forms.

It is of interest to note that not all the syncarps bear staminodia; and also that most of the staminate spadices bore conspicuous pistillodes, which are quite obviously arranged in spirals on the spadix. These characters seem to indicate that the species may be grouped with *F. an-*

gustifolia Bl. and *F. javanica* Bl., for these species are grouped together (in an unnamed section) and characterized by Solms-Laubach (Linnaea n. s., 8: 81. 1878) as follows: "I. Antherae in flore masculo subsessiles filamento brevissimo instructae, post florescentiam mox evanidae."

Freycinetia grayana Perry in Journ. Arn. Arb., 31: 212. 1950.

Scandent; branches toward the distal ends about 5 mm thick, with internodes of about 1 cm, the leaves not thickly crowded; leaves short and proportionately rather broad, about 7–11.5 cm long and 1–1.9 cm broad, the apex gradually attenuate-acuminate; margins entire, or at the apex slightly callose and with 1 or 2 obsolete teeth; margin toward the apex dorsally remotely denticulate; auricles deciduous; inflorescences terminal; staminate spadices unknown; pistillate spadices ternate, the peduncles 2–2.5 cm long, minutely and rather sparsely appressed-setulose scabrid mostly on the angles; common peduncle short, about 5 mm long; syncarps broadly oblong, 2–2.5 cm long, 1.5–1.8 cm thick; berries lageniform, 6–7 mm long, the apex bounded by a pale ring; stigmas 3–8, mostly about 4–5; immature seeds about 1 mm long, narrowly fusiform (about 0.15–0.2 mm thick), minutely striate, with a narrow inconspicuous raphe bearing a few raphidophorous cells; strophiole lacking.

Type locality: Vanua Levu: Mbua ("Sandalwood") Bay, U. S. Explor. Exped. 1838–42 (type in GH; dupl. at USNM).

Distribution: Endemic; known only from Vanua Levu.

No other collections of this rather characteristic species have been found. The species remains known only from the type specimen.

Freycinetia vitiensis Seem. Fl. Vit., 282. pl. 83. 1868; Solms-Laubach in Linnaea n.s., 8: 105. 1878; Warb. in Pflanzenr., 3(IV.9): 35. 1900; Martelli in Webbia, 3: 315. 1910 and in Univ. California Publ. Bot., 12: 326. nomen solum. 1930; Perry in Journ. Arn. Arb., 31: 213. 1950.

Scandent, slender, with stems to 4–5 mm in diameter, internodes of 5–9 mm, bark on older branches thin, pale brown; leaves narrow lanceolate, gramineous, 7–15 cm long and only 3–8 mm broad, slightly narrowed toward base, long-attenuate and subacuminate at apex, the margins smooth and entire for most of their length, at apex minutely and sparsely denticulate; costa dorsally sparsely denticulate at apex; auricles fragile, membranous, deciduous, about 5–8 mm long and 2 mm broad; inflorescences terminal; staminate flowers unknown; pistillate inflorescence of 3 small subglobose syncarps borne on slender pedicels about 1.7–3 cm long and 1–1.5 mm thick, setulose-scabrid throughout (especially toward apex) with appressed ascending setulae; syncarps about 1–1.5 cm in diameter, with few (50–60) berries; berries free in pilear portion (nearly half), about 5–6 mm long and 2–3 mm thick; pileus acuminoid, truncated; stigmatic areola 0.7–1.0 mm broad, rim smooth and rounded; stigmas mostly 4–5–6; seeds about 0.6–0.7 mm long,

semiellipsoid to sublunulate, with a narrow but obvious raphe with a few shining raphidophorous cells; strophiole absent or extremely minute.

Type locality: Viti Levu, Voma Peak (Seemann 647, K).

Distribution: Viti Levu, Vanua Levu, Taveuni.

Local names: *merimeri* (Taveuni); *nembanemba* (Vanua Levu).

No specimens of this species have come to hand since Perry's paper (1950).

The species is diminutive and quickly recognized; its closest relative is *F. graeffei*.

Freycinetia graeffei Martelli in Univ. California Publ. Bot., 12: 326. pl. 37. 1930; Perry in Journ. Arn. Arb., 31: 212. 1950.

Scandent; older stems subterete, to 7–8 mm in diameter, with a pale thin brownish bark; younger stems usually 4–5 mm thick, the internodes short, the leaf-bases overlapping, slightly sheathing; leaves mostly 16–36 cm long, and (3–) 6–13 mm broad, linear-lanceolate, gradually attenuate toward the subulate apex or very slightly acuminate, slightly narrowed and duplicate at base; margins toward apex and base for a short space minutely denticulate; costa dorsally smooth except at apex minutely denticulate; auricles membranous, mostly 15–20 mm long and about 3 mm broad, narrow, entire, adnate, fragmenting into semipersistent fibers or longitudinal pieces, at last mostly deciduous; staminate inflorescences unknown; pistillate inflorescences terminal, usually of 2 or 3 syncarps on slender pedicels about 2.5–3.8 cm long and 1.5–3 mm thick, spinulose-setulose all around at the distal ends and below along the angles with a few spinules on the faces, densely so at apex, more sparsely toward base; syncarps subglobose to short ellipsoid, about 1.7–2.5 cm long and nearly as broad; berries free in the upper rigid part, the narrow pilei angled and attenuate upward, about 2 mm long; berries at maturity about 8–9.5 mm long and 2–3 (–4) mm thick, often somewhat compressed, succulent in the lower portion; pileus truncate, the stigmatic areola 0.8–1.8 mm across, bounded by a smooth slightly rounded brown rim; stigmas mostly 4–6, often 7–11, rarely to 13, flush, dark; seeds 0.7–1.0 mm long, narrowly fusiform, linear or very slightly curved, with a very narrow inconspicuous raphe with only a few raphidophorous cells; strophiole lacking.

Type locality: Viti Levu: Namosi prov. (Graeffe 243, in herb. Hamburg). Martelli cites a considerable number of collections, without definitely designating a type; but the Graeffe specimen had been seen and named by him long before the description was published, so probably should be considered the type.

Distribution: Endemic to Fiji; known from Viti Levu, Ovalau, and Vanua Levu.

Local names: *wa me* (Viti Levu); *merimeri* (Vanua Levu).

Martelli and Perry cite a number of specimens. Only those of the present collection follow.

Viti Levu: Serua: Hills between Waininggere and Waisese Creeks,

between Ngaloa and Wainiyambia, dry lowlands (Smith 9557). Namosi: Hills north of Wainavindrau Creek, between Korombasambasanga Range and Mt. Naitarandamu (Smith 8501). Naitasiri: Tholo-i-Suva (Nand, Fiji Dept. Agric. 10255).

A species certainly very closely related to *F. degeneri*, and to *F. hombronii* Martelli of Samoa; from the latter it may be distinguished by the smaller, finer, less closely appressed, and thinner more hairlike spinulose setae of the pedicels.

Freycinetia degeneri Merr. and Perry in Sargentia, 1: 4. 1942; Perry in Journ. Arn. Arb., 31: 212. 1950.

Scandent; branches toward the apex 6 mm thick, with very short internodes of 2–3 mm; leaves 20–25 cm long, about 9 mm broad, gradually attenuate-acuminate and almost subulate toward apex, the basal and apical portions of the margins shortly and inconspicuously serrate-denticulate; auricles fragmenting and deciduous; inflorescences terminal; staminate flowers unknown; pistillate inflorescences ternate, about 5 cm long, the spathes caducous, the pedicels about 3 cm long, very minutely and sparsely spinulose-setose only along the angles, elsewhere smooth; syncarps subglobose, when immature about 1.5 cm in diameter or 1.5 cm long and 1 cm thick; berries numerous, sublinear to sublageniform, angled, when dry 4–5 mm long, free nearly to base; apex with a pale annulus surrounding the 2–4 stigmas; seeds (immature) fusiform.

Type locality: Viti Levu: Serua prov.: Vatuvilakia, vicinity of Ngaloa; the type is Degener 15128 (A).

Distribution: Known only from the type.

Local uses: Degener notes that the fresh roots, pounded to extract the fibers, are used in binding grass for thatch houses.

No specimens of this species, other than the type, are at hand, and none were cited by Perry; until specimens with mature fruits are available, nothing can be said of the relationships of the species which may prove not to be distinct from *F. graeffei*.

Freycinetia parksii Martelli in Univ. California Publ. Bot., 12: 330. pl. 39. 1930; Perry in Journ. Arn. Arb., 31: 210. 1950.

Scandent; stems to 1 cm in diameter; leaves linear-lanceolate, coriaceous, mostly 50–77 cm long and 3–5 cm broad, attenuate-acuminate and subulate at apex, amplexant and canaliculate at base, margins at base and apex dentate-serrate, midrib dorsally spinulose-denticulate toward apex, elsewhere unarmed; auricles about 5–8 cm long and 4–9 mm broad, gradually attenuate above, membranous, deciduous; inflorescences terminal; staminate inflorescences unknown; pistillate inflorescences of 3 or 4 syncarps on a stout (7–10 mm) common peduncle surrounded by caducous spathes; pedicels mostly 4–5 cm long and 4–5 mm thick, trigonal, flattened ventrally, smooth proximally except on the setulose-scabrid angles, densely setulose all around at the distal end; syncarps cylindric, mostly 4–8 cm long and 2.5–3.5 cm in diameter;

berries numerous, crowded, usually 1.7–2.8 cm long, the pileus rigid, about 4–5 mm long, narrowly pyramidal subrostrate, the stigmatic areola generally less than 1 mm broad; stigmas (4–) 5–8; seeds (slightly immature) 0.7–0.8 mm long, ellipsoid, linear or slightly curved, the raphe narrow and inconspicuous; strophiole lacking.

Type locality: Viti Levu, Lami, Head of Suva Harbor (Parks 20045).

Distribution: Endemic to Fiji, known so far from Viti Levu, Kandavu, Vanua Levu, and Ovalau, in forests from sea-level to 1120 m altitude.

Local names: *wa me*, *merimeri* or *meri*, *vandra*; the latter probably a misapplication (*vandra* usually applied to *Pandanus*).

In addition to the specimens cited by Martelli and Perry, the following more recent collections are of this species:

Fiji: Viti Levu: Ra: Mt. Nanggaranambuluta (Lomalangi), near Nandarivatu (Parham, Fiji Dept. Agric. 10399); Namosi: Hills north of Wainavindrau Creek, between Korombasambasanga Range and Mt. Naitarandamu (Smith 8472); Tailevu: Hills east of Wainimbuka River near Ndakuivuna (Smith 7051); Naitasiri: Tholo-i-Suva (Burnett, Fiji Dept. Agric. 11537; Parham, Fiji Dept. Agric. 7568). Ovalau: Summit of Mt. Ndelaiovalau and adjacent ridge (Smith 7555); Summit of Mt. Korotolutolu west of Thawathi (Smith 8046).

This species, together with *F. milnei* Seem., includes individuals which are among the largest of the genus (as to stems, leaves, and fruits) to be found in Fiji.

Freycinetia storckii Seem. Fl. Vit., 283. pl. 85. 1868; Solms-Laubach in Linnaea n.s., 8: 104. 1878; Warb. in Pflanzenr., 3(IV.9): 38. 1900; Gibbs in Journ. Linn. Soc. Bot., 39: 179. 1909; Martelli in Webbia, 3: 315. 1910; in Univ. California Publ. Bot., 12: 331. 1930; Perry in Journ. Arn. Arb., 31: 211. 1950.

F. gillespiei Martelli in Univ. California Publ. Bot., 12: 329. pl. 38. 1930.

Scandent, with stems to 7–8 mm in diameter, the internodes short, covered by the overlapping leaf bases; leaves thin coriaceous, narrowly linear, about 40–55 cm long and 1.5–2.5 cm broad, gradually attenuate-acuminate to a subulate subcaudate apex; margins at base (for about 1 cm) and at extreme apex sparsely denticulate, medially unarmed; costa dorsally near apex remotely spinulose-denticulate; auricles about 3–5 cm long, 4–5 mm broad, membranous, deciduous; inflorescences terminal; staminate flowers unknown; pistillate inflorescence of 2 or 3 syncarps on slender pedicels 3.5–4.5 cm long and about 3 mm thick, smooth except for the sparsely setulose angles; syncarps oblong, about 3.5–5 cm long and 1.8–2.4 cm thick, dull yellow; berries numerous, slender, angular, about 10–11.5 mm long and about 3.5 mm broad, pileus pyramidal, truncate, about 2 mm long, the stigmatic areola about 1 mm broad, the stigmas mostly 4–9; seeds slender, about 0.6–0.7 mm long (still slightly immature), nearly 0.3 mm broad, with a slender but obvious translucent raphe with a few shining raphidophorous cells (the

raphe about 0.05 mm broad, running the length of the seed); strophiole absent.

Type locality: Taveuni (Seemann 695, K).

Distribution: Endemic; known from Taveuni and Viti Levu, up to 1000 m, and Vanua Levu to 350 m.

Local names: *meri*, or *merimeri*.

Fiji: Viti Levu: Gibbs 870; further specimens cited by Martelli (1930) and Perry.

Vanua Levu: Mathuata: Southern slopes of Mt. Numbuiloa, east of Lambasa (Smith 6384). Thakaundrove: Mt. Mbatini, summit (Smith 689).

I am relying on Perry's determination of the species, as well as the description and good figure by Seemann. In the specimen cited, the pedicels are nearly glabrous, but bear sparse setae along the angles; the apices of the pedicels are not densely scabrid all around, as those of *F. parksii* and *F. gillespiei*. However, the latter probably is not distinct from *F. storckii*, according to Perry; and since virtually all other characters are essentially the same, I have listed *P. gillespiei* as a synonym.

Freycinetia milnei Seem. Fl. Vit., 283. pl. 86. 1868; Solms-Laubach in Linnaea, 42 (n.s. 8): 102. 1878; Warb. in Pflanzenr., 3(IV.9): 41. 1900; Gibbs in Journ. Linn. Soc. Bot., 39: 179. 1909; Martelli in Webbia, 3: 313. 1910, in Univ. California Publ. Bot., 12: 330. 1930; Perry in Journ. Arn. Arb., 31: 210. 1950.

Scandent; stems up to 1 cm in diameter, with internodes to 1 cm long; leaves coriaceous, crowded, stiffly or moderately coriaceous, mostly 30–67 cm long and (1.3–) 2.4–3.8 cm broad, attenuate-acuminate and subulate (rarely merely sharply acuminate) at apex, amplexent and canaliculate at base, margins serrulate-denticulate for a short space at base, serrulate-denticulate to serrate-dentate toward apex, elsewhere smooth; median costa dorsally spinulose-denticulate only toward apex; auricles subpersistent, membranous, fragmenting laterally, attenuate toward apex, mostly 6–9 (–10) cm long and 5–10 mm broad; inflorescences terminal, the staminate infl. unknown; pistillate spadices mostly 3 or 4 on smooth, quite glabrous pedicels mostly 4.5–6.5 cm long and 3–8 mm thick, slightly angled, arising from a short stout common peduncle; syncarps cylindric, 5–12 cm long and 2–3.5 cm in diameter; berries numerous, crowded, compressed or subpentagonal, linear-oblong, mostly 9–10 mm long or to 11 mm, about 2–3 mm broad, the pileus rigid, angled, with nearly parallel to very slightly tapered sides, hence suboblong or obscurely pyramidal, truncated, the stigmatic areola usually 1–1.5 mm broad, with a smooth rounded rim; stigmas mostly (4–) 5–8, rarely 9 or sometimes more; pericarp membranous, with a few scattered raphidophorous cells; seeds ellipsoid, very slightly curved, about 0.9 mm long and 0.3 mm broad, the raphe slender, obvious,

usually with 2 rows of shining raphidophorous cells; strophiole lacking or extremely minute.

Type locality: Vanua Levu (Milne and Seemann 648, syntypes).

Distribution: Endemic to Fiji; known from Viti Levu, Vanua Levu, Taveuni, and Ngau; a strong woody climber in forests from near sea-level up to 1323 m altitude.

Local names and uses: *vukavuka* (teste Milne); *wa me, wa meri*, and *merimeri* (Smith). The stems are said to be useful for binding house-timbers; and Seemann states that the fruits may be eaten.

Specimens additional to those previously cited by Seemann, Martelli, and Perry:

Viti Levu: Serua: Flat coastal strip near Ngaloa (Smith 9437). Namosi: Hills bordering the Wainavindrau Creek in vicinity of Wainimakutu (Smith 8566, one duplicate with exceptionally narrow leaves; 8613); Hills east of Wainikoroiluva River near Namuamua (Smith 9055). Taveuni: Summit and adjacent slopes of Mt. Manuka east of Wairiki (Smith 2839). Ngau: Hills east of Herald Bay, inland from Sawaieke (Smith 7798).

The specimens are rather uniform except for Smith 8566, in which the leaves are narrower than usual; one of the set is characterized by leaves nearly 60 cm long and but 1.3 cm broad; in breadth close to specimens of *F. pritchardii* Seem.

The species is related very closely to *F. urvilleana* Hombr. and Jacquinot of Tonga; and were there more ample and mature specimens of this species available, it might be possible to show that but one species is involved, which would then bear the older name *urvilleana*. Material of this Tongan species which I have studied was inadequate (all the syncarps were too immature), but in other features there are few if any significant differences. This species, together with *F. pritchardii* and *F. storckii*, and *F. urvilleana*, if distinct, form a group with a number of common features recognizable by foliar characters, the glabrous pedicels, and the berries.

Freycinetia pritchardii Seem. Fl. Vit., 283. pl. 84. 1868; Solms-Laubach in Linnaea n.s., 8: 104. 1878; Warb. in Pflanzenr., 3(IV.9): 37. 1900; Gibbs in Journ. Linn. Soc. Bot., 39: 179. 1909; Martelli in Webbia, 3: 314. 1910; in Univ. California Publ. Bot., 12: 328. 1930; Perry in Journ. Arn. Arb., 31: 211. 1950.

Scandent; stems about 7 mm in diameter, the internodes about 4–6 mm long; leaves coriaceous, linear, about 28–30 cm long and 10–16 mm broad, gradually attenuate-acuminate toward apex, not caudate, at base briefly plicate-canaliculate and amplexant; margins near base and apex sparsely and remotely or obsoletely denticulate; often unarmed; apex often somewhat callose; costa dorsally remotely and sparsely denticulate near apex, or nearly unarmed; auricles membranous, about 2–3 cm long and 6–10 mm broad, lanceolate, upwardly attenuate, rounded and broader at base, fragmenting laterally and at last deciduous; in-

florescences terminal; staminate inflorescence with lanceolate foliaceous outer bracts 7–11 cm long and about 2 cm broad, long-acuminate, their margins and dorsal costa denticulate only at apex; inner spathaceous bracts about 5–7 mm long, acute or short-acuminate; spadices about 2.5 cm long, about 0.5 cm thick, on smooth pedicels about 2 cm long; stamens in small clusters rising from the base of spirally arranged folds in the fleshy receptacle; pistillate inflorescence of 3 syncarps, on a short (8 mm) peduncle, the pedicels about 3–4 cm long, semicircular in cross-section, dorsally rounded, smooth and glabrous, the syncarps oblong, about 3.2–4 cm long and 1.6–2 cm in diameter; berries numerous, about 8 mm long and 2–2.5 mm broad (immature), mostly pentagonal, the pileus about 2.5–2.8 mm long, rigid, the pericarp with a few scattered raphidophorous shining cells, the apex truncate, the stigmatic areola subcircular, smooth-edged, the stigmas mostly 4–5 (–8) in number, sometimes confluent; seeds “less than 1 mm long, ellipsoid, acute at both ends” (Martelli); in our specimens immature.

Type locality: Viti Levu, Voma Peak (Seemann 609, K).

Distribution: Endemic to Fiji, found so far only in Viti Levu and Ovalau, as a climber in forests, up to 1000 m elev.

Local name: *wa me*.

A number of specimens are cited by Martelli (1930) and by Perry; the latter describes the staminate inflorescences.

Additional specimen examined: Fiji: Ovalau: Summit of Mt. Tana Lailai, and adjacent ridge, Smith 7698.

Freycinetia intermedia Merr. and Perry in Sargentia, 1: 4. 1942; Perry in Journ. Arn. Arb., 31: 211. 1950.

Scandent; stems up to 10 mm thick, the younger ones mostly 4–5 mm thick; annulate below the foliose portion by leafscars; internodes short, leaf bases overlapping; leaves linear-lanceolate, about 29–45 cm long and 1.2–2 cm broad, gradually attenuate to the subulate subcaudate apex, slightly narrowed at base; margins along apex (especially on cauda) and near base denticulate, medially smooth; costa dorsally denticulate toward apex; auricles membranous, deciduous, fragmenting into fibers; staminate inflorescences unknown; pistillate inflorescences terminal, ternate, the spadices on long slender quite glabrous pedicels 2–3 cm long and 1–2 mm thick; syncarps shortly oblong subellipsoid, about 2–4 cm long and 1–2.5 cm thick; berries about 8.5 mm long and 3 mm thick, obpyramidal, the lower part succulent, the upper 2 mm an attenuate acuminoid pyramidal pileus almost rostrate, truncate, the stigmatic areola about 0.7–1.0 mm across, bounded by a smooth rounded brownish rim, the stigmas usually 4, often 3, sometimes 2, flush or nearly so; seeds fusiform-ellipsoid, about 0.9–1.0 mm long and nearly 0.3 mm thick, slightly narrower at the distal end, the raphe narrow and inconspicuous; strophiole lacking.

Type locality: Viti Levu: Serua province, vicinity of Ngaloa, Mt. Ngamo; type is Degener 15054(A).

Distribution: Endemic to Fiji; known only from Serua province, Viti Levu.

Local names and uses: *wa me*; the roots are pounded in water, the bark removed, and the fibers thus obtained used in house-building.

Viti Levu: Serua: Hills west of Waivunu Creek, between Ngaloa and Korovou, dry lowlands (Smith 9324).

The single additional collection bears nearly mature syncarps, which allow a more accurate description of the berries and seeds; they are not completely mature, but probably have attained their maximum size. The larger syncarp is crushed, and its exact dimensions not precisely ascertainable; the description is probably reasonably close, however. The seeds show that this species is related to *F. graeffei* and *F. degeneri*.

Freycinetia in Tonga

Only one species is known from Tonga; it is a member of Sect. *Freycinetia*.

F. urvilleana Hombr. and Jacquinot in Dumont d'Urville, Voy. Astrolabe et Zélée, Bot. Atlas, Monocot. t., 2. 1852; descr. tab. Bot., 2: 83. 1853; Solms-Laubach in Linnaea n. s., 8: 106. 1878–1879; Warb. in Pflanzenr., 3(IV.9): 38. 1900; Martelli in Webbia, 3: 315. 1910; in Univ. California Publ. Bot., 12: 354. 1930; Yuncker in Bishop Mus. Bull., 220: 48. 1959.

Type locality: Tonga: Vava'u (Hombron). Solms-Laubach inadvertently placed this locality in Timor.

Reported from 'Eua (Parks 16279, Yuncker 15433).

Scandent climber (to 30 m or more), the stems distally "as thick as a finger," with short internodes, foliose; leaves close together, imbricate, coriaceous, 50–60 cm long and 3–5 cm broad, or somewhat narrower in the male, dilated at base, attenuate-acuminate and subulate at apex; auricles 7–8 cm long, about 5–7 mm broad (at base), submembranous, entire, adnate and rounded to tapering-decurrent distally; margins unarmed except along the denticulate apex; costa unarmed except along the apex, there serrate-denticulate; inflorescence terminal; syncarps 3, cylindric, 9–10 cm long and about 2.5 cm in diameter, of very numerous carpels; pedicels robust, to 6 cm long and 5 mm thick, smooth and glabrous; berries crowded, elongate, acutely angulose, apically truncate, the seminiferous part much longer than the pileus, at base surrounded by staminodes; stigmas 5–10; seeds subulate, elongate; staminate inflorescence similar, the spadices about 5 cm long.

According to Yuncker, the Tongan name for the species is "kahikahi."

This species appears to be rather closely related to *F. milnei* Seem., differing in the tapered and adnate auricles, the larger syncarps, and somewhat broader leaves; but it is possible that they are not distinct, in which case the Tongan species name would take precedence.

Freycinetia in Samoa

Although Martelli's treatment of Samoan Pandanaceae (*in* Bishop Mus. Occ. Pap., 10 (n. 13). 1934) fully describes the three Samoan species of *Freycinetia*, a key has not been available. To meet this need the following key is presented.

Key to Samoan *Freycinetia*

1. Stigmas mostly 3-10 or more. Sect. *Freycinetia*
2. Leaves about 70 cm long, dilated at base to 5-6 cm breadth; pedicels scabrid, 4.5-5 cm long; syncarps broadly cylindric, about 5.5 x 1.5 cm; stigmas 4-6. *samoensis* Warb.
- 2'. Leaves about 40 x 1-1.8 cm with auricles about 5-6 cm long; pedicels distally spinulose-scabrid on the angles, 2-3 cm long; syncarps mostly 4-5 (-6) cm long and 2 cm thick, or sometimes only 1.5-3 cm long and subglobose; berries about 7 mm long, with 4-5 stigmas. *hombronii* Martelli.
- 1'. Stigmas mostly 1-3, rarely 4-5. Sect. *Oligostigma*
 Leaves about 60-100 (or more) cm long, 2.5-5.5 cm broad; auricles up to 13 cm long; pedicels glabrous, 3.5-5 cm long; syncarps 3-4, about 7-9 cm long and 2.5-3 cm in diameter; berries about 13 mm long, with 2 stigmas. *reineckei* Warb.

Sect. *Freycinetia*

F. samoensis Warb. *in* Bot. Jahrb., 25: 579. pl. 8. Fig. A. 1898; Martelli *in* Rechinger, Denkschr. Akad. Wiss. Wien, 85: 230. 1910; *in* Bishop Mus. Occ. Pap., 10 (13): 4. 1934.

Type locality: Samoa: Savaii (Reinecke 355c). Syntype from Tutuila (Reinecke 362a).

F. hombronii Martelli *in* Rechinger, Wiss. Forschungsreise nach Samoa, 56. 1910; *in* Denkschr. Akad. Wiss. Wien, 85: 230. 1910; *in* Bishop Mus. Occ. Pap., 10(13): 5. 1934. Yuncker *in* Bishop Mus. Bull., 184: 21. 1945.

Type locality: Samoa: Upolu (Rechinger 1671). Syntype also from Upolu (Rechinger 1302). Reported from Tau by Yuncker.

Sect. *Oligostigma*

F. reineckei Warb. ex Reinecke *in* Bot. Jahrb., 25: 578. pl. 8. Fig. B. 1898; Martelli ex Rechinger *in* Denkschr. Akad. Wiss. Wien, 85: 229 Fig. 3. 1910; *in* Bishop Mus. Occ. Pap., 10(13): 3. 1934; Yuncker *in* Bishop Mus. Bull., 184: 22. 1945.

Type locality: Samoa: Savaii (Reinecke 255). Syntypes from Savaii and Upolu (Reinecke 255a, 255b, 353a, 362). Reported from Tutuila and Tau.

Samoa: Savaii: U. S. Explor. Exped. (USNM). Tutuila: Above Vatia on trail, over 300 m alt., June-July 1920, Setchell 343 (USNM).

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

TAXONOMIC STATUS OF THE MOLOSSID BAT,
CYNOMOPS MALAGAI VILLA-R, 1955

BY J. KNOX JONES, JR.

Museum of Natural History, The University of Kansas

The dog-faced bats of the genus *Cynomops* are primarily South American in distribution. The genus is known in North America only from Panamá, with the exception of *Cynomops malagai* Villa-R, the holotype of which is from Tuxpan de Rodríguez Cano, Veracruz (Acta Zoologica Mexicana, 1(4):2, September 15, 1955). A second specimen from Veracruz and another from Peto, Yucatán, were referred to *C. malagai* in the original description.

The presence of a large, long-undetected species of *Cynomops* in southern México was somewhat puzzling, and on a recent visit to Mexico City I took the opportunity, through the courtesy of Villa, to examine the holotype of *C. malagai* in the collection of the Instituto de Biología, Universidad de México. The specimen (no. 1738, not 1783 as published), a female obtained on August 2, 1955, is not adult as claimed in the original description, but is an immature animal having unfused phalangeal epiphyses. The immaturity of the type accounts for the lack of a sagittal crest and most of the other characters by which *C. malagai* was alleged to differ from members of the genus *Molossus*. In fact, the holotype of *malagai* is indistinguishable, externally and cranially, from specimens of corresponding age of *Molossus nigricans* Miller, 1902 (as, incidentally, are the other specimens, nos. 1736-37, that were referred to *malagai* in the original description and the several specimens in the collection of the Instituto that subsequently have been referred to that species). Consequently, I regard *Cynomops malagai* as a synonym of the earlier-named *M. nigricans*, which currently is known as *Molossus ater nigricans* (Goodwin, Amer. Mus. Novit., 1994:4, March 8, 1960).

PROCEEDINGS
OF THE
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CONSPECIFICITY OF *PLAGIODONTIA AEDIUM*
AND *P. HYLAEUM* (RODENTIA)

BY SYDNEY ANDERSON

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In May, 1948, G. H. H. Tate (Jour. Mamm., 29: 176-178) reported two specimens of *Plagiodontia*, then alive in the collection of the New York Zoological Society. These two specimens (now American Museum of Natural History nos. 150016 and 150017, each a study skin and skull) are from the mountains of southern Haiti. Tate tentatively identified the two specimens as *Plagiodontia hylaeum*. In June, 1948, D. H. Johnson published a synopsis of the species of *Plagiodontia* (Proc. Biol. Soc. Washington, 61: 69-76).

The two specimens originally reported by Tate have now been compared, through the courtesy of Dr. David H. Johnson, with: (1) a series of nine specimens of *Plagiodontia hylaeum*; (2) the types of *Plagiodontia* in the U.S. National Museum, namely *P. spelaeum* Miller and *P. ipnaeum* Johnson, both of which are known only as fossils, and *P. hylaeum* Miller, which is presumably still living; (3) the specimen (USNM no. 282552) of *Plagiodontia aedium* F. Cuvier reported by Johnson; and subsequently, through the courtesy of Mr. Robert Grant Jr., (4) one additional specimen (not catalogued) from Haiti in the Academy of Natural Sciences of Philadelphia.

These comparisons provide new knowledge regarding variation and relationships in the genus *Plagiodontia*.

No. 150017 is atypical in color, being light orange brown and having pink eyes as described by Tate. No. 150016 matches the type of *P. hylaeum* in color of pelage. Both specimens match *P. hylaeum* in shape

and size of feet, and form of claws. Plantar and palmar granules seem larger than in *P. hylaeum*. At least part of the difference between *P. hylaeum* and *P. aedium* in size of granules on feet and tail and in apparent size of feet is attributable to the method of preservation; the specimen of *aedium* is in fluid, the specimens of *hylaeum* are dry. The difference in claws may have been caused by different amounts of wear. A difference in the length of the tail of 5 mm or even of 7 mm is not to be regarded as significant; the tail measurements taken by the preparator are 145 mm in no. 150016 and 152 mm in no. 150017. Other measurements, in mm, of these two specimens are respectively: total length 488 and 493, and length of hind foot 67 in both. The ears cannot be observed in these two specimens. In short, no external difference is well established between the two living species of *Plagiodontia*.

In regard to the skull and teeth Johnson noted that *aedium* differed from *hylaeum* in (1) smaller size, (2) almost obsolete postorbital processes, (3) evenly arched zygomata, (4) weaker rostrum, (5) palatal pits in line with back of first molar, rather than forward of this line, (6) U-shaped, rather than V-shaped anterior margin of pterygoid vacuity (7) not extending anteriorly beyond level of posterior margin of alveolus of M^3 , (8) shallower mandibular sulcus between articular and coronoid processes, (9) incisors narrower, (10) occlusal surfaces of cheek teeth smaller, (11) toothrows more nearly parallel, (12) less tendency toward reduction of posterior teeth, (13) presence of incipient fold at anterolateral corner of Pm^4 , (14) absence of fold at posterolateral corner of M^3 , (15) tips of labial and lingual folds of lower cheek teeth less pointed, and (16) sides of these folds less sinuous. The two new Haitian specimens (AMNH nos. 150016 and 150017) agree with *aedium* in characters 4, 5, 6, 8, 13, 15, and 16; they agree with *hylaeum* in characters 1, 2, 3, 10, 11, and 14. Of the other three characters, 7 is not characteristic of all *hylaeum* examined and in this character 150016 agrees with the usual condition of *hylaeum* while 150017 agrees with *aedium*. In character 9 specimen 150016 again agrees with *hylaeum* and again 150017 agrees with *aedium*. In character 12 both specimens are intermediate but seem nearer to *aedium*. In larger auditory bullae both specimens resemble *hylaeum*. In the aggregate of characters the two specimens seem slightly nearer *hylaeum*. However, considering that only three specimens of *aedium* have ever been reported and that only one is used in the above comparisons, the most notable fact is that the new Haitian specimens are nearly intermediate between and do combine the presumed characters of *P. hylaeum* and *P. aedium*. The exact locality in southern Haiti of the two new specimens is not known.

Karl F. Koopman kindly brought the following specimen to my attention. An uncatalogued specimen at the Academy of Natural Sciences of Philadelphia was obtained by Anthony Curtiss at Miragoane in Haiti, as was USNM no. 282552. The specimen was originally in preservative and was later prepared as a study skin and skull by W. V.

Kohler. It is an adult female and was obtained on "7-8-49." Measurements, in mm, taken by the preparator were: total length 452, length of tail 140, length of hind foot 69, length of ear from crown 8. A note on the label indicates that the stomach was filled with finely chewed plant material and that the right arm of the uterus had a swollen area 12 mm in diameter. The pelage is slightly paler than that of AMNH no. 150016, and only slightly paler ventrally than dorsally. The scales on feet and tail resemble those of AMNH no. 150016. The claws are relatively long and sharp. The pinnae have a distinct marginal fringe of hairs. In seven of the sixteen cranial and dental characters listed above, the Philadelphia specimen resembles *aedium* (characters 2, 3, 5, 11, 13, 15, and 16) and in nine characters it resembles *hylaenum* (1, 4, 6, 7, 8, 9, 10, 12, and 14).

This specimen, like the two American Museum specimens, combines characteristics of *aedium* and *hylaenum*. The only characters that distinguish all four Haitian specimens from *hylaenum* are cranial characters 5, 13, 15, and 16.

Unless, and until, new material shows a better separation of the two forms the most reasonable interpretation is that the living *Plagiodontia* are of one species. Available Haitian material then is referred to *Plagiodontia aedium aedium* F. Cuvier, 1836, and available Dominican Republic material is referred to *Plagiodontia aedium hylaenum* Miller, 1927.

PROCEEDINGS
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A REVIEW OF THE COLUBRID SNAKE GENUS
ARRHYTON WITH A DESCRIPTION OF A NEW
SUBSPECIES FROM SOUTHERN ORIENTE
PROVINCE, CUBA

BY ALBERT SCHWARTZ

The colubrid snake genus *Arrhyton* occurs on Cuba and the Isla de Pinos. Prior to 1959, several species were recognized; in that year a major "break through" in the systematics of the genus was made by Grant, Smith, and Alayo (1959), who resurrected *Arrhyton dolichurum* Werner for a very distinct species, and settled the status of the name *Colorhogia redimita* Cope, the type of which had previously been lost. As presently understood, there are three species: *Arrhyton taeniatum* Gunther, 1858 (including *Colorhogia redimita* Cope, 1863, and *Arrhyton fulvum* Cope, 1863), *Arrhyton vittatum* Gundlach and Peters, 1862 (including *Arrhyton bivittatum* Cope, 1863), and *Arrhyton dolichurum* Werner, 1909.

At about the same time as the Grant, Smith, and Alayo paper was in preparation, I had had occasion to borrow most if not all the specimens of *Arrhyton* in American collections, since I had collected two specimens of what was then an apparently new species in Cuba; this "new species" was in actuality Werner's *A. dolichurum*. In addition to American specimens, which had never previously been studied in ensemble, I also borrowed material from the Museo Poey at the Universidad de la Habana and from the Museo y Biblioteca de Zoología de la Habana. The study of all this material was most revealing, but because of the fresh publication of the Grant *et al.* paper there seemed little purpose in publishing another review of this small genus. I have recently borrowed some fresh material which had not been previously studied, and this allowed me to re-evaluate the data which I had. It seems

appropriate at this time to publish this compact study, since much of the material upon which it was based is no longer available to American workers.

My work in Cuba was under the sponsorship of two National Science Foundation grants (G-3865 and G-6252), and I am especially indebted to the National Science Foundation for making my Cuban field work possible. Material was borrowed from the following institutions and I am grateful to the respective curators for allowing me to study these specimens: Mr. Charles M. Bogert, American Museum of Natural History (AMNH); Dr. James N. Böhlke, Academy of Natural Sciences of Philadelphia (ANSP); Mr. Neil D. Richmond, Carnegie Museum (CM); Dr. Carlos G. Aguayo, at that time at the Museo Poey, Universidad de la Habana (MP); Dr. Ernest E. Williams and Mr. Benjamin Shreve, Museum of Comparative Zoology (MCZ); Sr. Miguel Jaume, Museo y Biblioteca de Zoología de la Habana (MBZH); the late Dr. Norman E. Hartweg and Dr. Thomas M. Uzzell, Jr., Museum of Zoology, University of Michigan (UMMZ); and Dr. Hobart M. Smith, University of Illinois Museum of Natural History (UIMNH). Again, Dr. Williams has pointed out to me some fresh material in his collection, and has relinquished his own claims to the description of a new subspecies; for this courtesy I am in his debt. My own field work plus the above borrowed material results in the data for seventy-four specimens whereas Grant *et al.* examined forty-five.

For assistance to me in the field in Cuba, I wish especially to thank the following: Williams H. Gehrmann, John R. Feick, Ronald F. Klinikowski, David C. Leber, Dennis R. Paulson, James D. Smallwood, Barton L. Smith, Richard Thomas, and George R. Zug. Messrs. Leber and Klinikowski had National Science Foundation Undergraduate Research Participation grants for part of their field work in Cuba. Mr. Klinikowski, in addition, is responsible for the illustrations for the present paper, for which I am once again very grateful.

KEY TO CUBAN FORMS OF *ARRHYTON*

1. Loreal absent (but see text); lateral stripe on scale rows 4 to 6;
ventrals 172–182 in males, 173–189 in females *taeniatum*

| | |
|--|--------------------|
| 1'. Loreal present; lateral stripe on scale rows 3 and 4 | 2 |
| 2. Subcaudals 132-133 in males, 104-121 in females | <i>dolichurum</i> |
| 2'. Subcaudals 52-111 in males, 52-80 in females | 3 |
| 3. Ventrals + subcaudals 196-252 in males, 193 in females | <i>v. landoi</i> |
| 3'. Ventrals + subcaudals 171-196 in males, 165-186 in females | <i>v. vittatum</i> |

Arrhyton taeniatum Günther, 1858

Arrhyton taeniatum Günther, 1858, Cat. snakes British Mus.: 244

Colorhogia redimita Cope, 1863, Proc. Acad. Nat. Sci. Philadelphia: 81

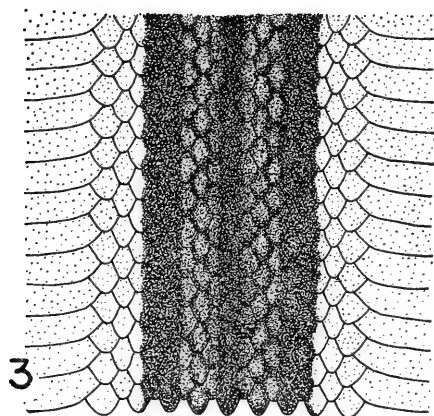
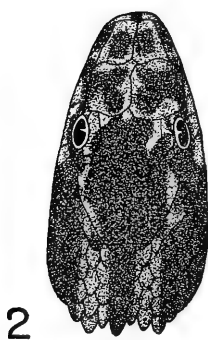
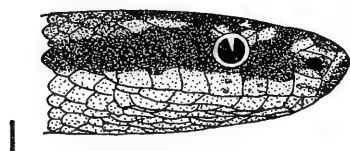
Arrhyton fulvum Cope, 1863, Proc. Acad. Nat. Sci. Philadelphia: 82

Description: A moderately sized, distinctly lined, glossy snake with upturned rostral, ventrals 172-182 in males and 173-189 in females, subcaudals paired, 73-93 in males and 76-84 in females; head conspicuously flattened and broad; dorsal pattern a series of five longitudinal lines, the most lateral of which lies almost wholly on scale rows 4 to 6 (Fig. 3), but may overlap slightly below onto scale row 3 and above onto scale row 7 occasionally; lined pattern most pronounced in juveniles, and in adults somewhat obscured but still present, due to the darkening of the light areas with added brown pigment; ventral surface completely immaculate, creamy white in preserved specimens and presumably so in life; largest male, total length, 554 mm, tail 153 mm; largest female, 585 mm, tail 137 mm; ratio of tail to total length, 25.7 (23.2-27.8) in males, 24.4 (22.6-26.7) in females; loreal absent; prefrontals two; pattern on top of head an irregular but symmetrical series of dark blotches involving all dorsal head scales, with a more or less distinct dark cap, separated from the postocular beginning of the dark lateral line by a light supraocular line which expands just behind the parietals into the dorsal light lines (Figs. 1 and 2); upper labials usually light, but anteriormost and rostral may have dusky centers; all lower labials immaculate, except that the mental and the first two lower labials usually have dusky mottling or stippling, which may extend more posteriorly onto the lower labials and may also involve the first pair of chin shields; scale rows usually 17-17-17, upper labials usually 7/7, lower labials 8/8 or 9/9; one preocular and two postoculars on each side.

To the above description may be added the following pertinent points from Grant *et al.* (1959). Subcaudals may reach 98 (sex unknown, but probably male); loreal may be present, as in the type of *redimitum*, which is the only known specimen having this condition; prefrontal may be single (fused), although this condition was not noted in any to the twenty-one specimens I have examined. Grant *et al.* (*op. cit.*: 132) noted it in five of eighteen *taeniatum* (at least three of which are from Oriente Province).

Distribution: known from Cuba and the Isla de Pinos (Fig. 13).

Remarks: I have examined 21 specimens of *A. taeniatum*, 12 males,



FIGS. 1-3. *Arrhyton taeniatum*, AMNH 46684, El Cotorro, Habana Province, Cuba, lateral and dorsal views of head, pattern at midbody.

8 females, and one in which the sex cannot be determined. There is little noticeable difference in scalation throughout the island of Cuba, although the specimen from Pinar del Río has the highest count of ventrals (189) of all specimens examined. No differences in pattern are apparent in the Cuban material. The single individual (a male) from the Isla de Pinos is remarkable in that it has an unusually high number of subcaudals (although Grant *et al.* give a subcaudal high of 98 for the species); the snake is badly hacked about the body, and accurate count of ventrals is impossible, but there are at least 172 ventral scutes. The Isla de Pinos snake likewise has the dorsal pattern relatively obscure for its medium size; additional specimens would be of interest.

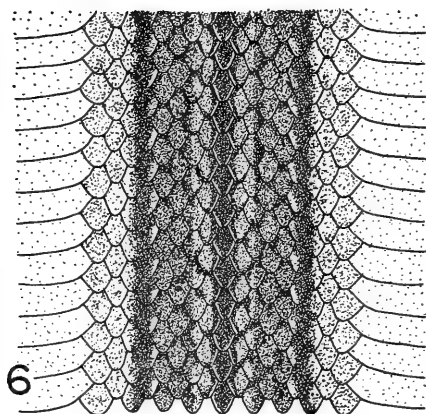
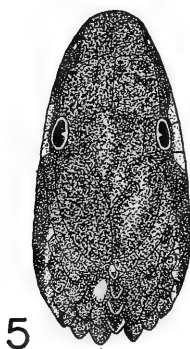
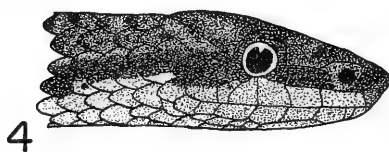
Specimens examined: CUBA, Pinar del Río Prov., San Vicente (AMNH 77781); Habana Prov., Cojimar (MCZ 8507); El Cotorro, 2 (AMNH 46684-85); Las Villas Prov., Soledad, 11 (MCZ 10916, MCZ 12356-57, MCZ 22705-11 plus one untagged skin); Guayanaro (USNM 139734); Oriente Prov., Guama (USNM 29768); Ciudadamar, Santiago de Cuba (UIMNH 49304) (AMNH 20384); Barrederas (MP 475); Isla de Pinos, no further locality (CM 1877).

Arrhyton dolichurum Werner, 1909

Arrhyton dolichurum Werner, 1909, Mitt. Naturh. Mus. Hamburg, vol. 26: 224

Description: A moderately sized, iridescent, distinctly lined, almost racer-like snake with a slightly upturned rostral, ventrals 145 and 146 in males and 125-141 in females, subcaudals paired, 132 and 133 in males, 104-121 in females; head slightly flattened and broad; dorsal pattern a series of three longitudinal dark brown bands, the most lateral of which lie on scale rows 3 and 4 (Fig. 6), and the median band involving the median and less than half of the paramedian rows to above the vent, and on tail occupying the median third of the paired paramedian scales; scales between longitudinal lines brownish, and on body with their anterior portions darker brown; on the dorsal surface of the tail, the brown anterior portions become more prominent and form a block-like pattern involving the longitudinal lines, giving the appearance of a woven or braided tail; ventral surfaces immaculate yellow in life, except for a few brownish punctations on the mental and the first four labials; largest male, total length, 542 mm, tail 236 mm; largest female, 452 mm, tail 187 mm; ratio of tail to total length, 41.9-43.5 in males, 41.2-41.4 in females; loreal present; prefrontals two; pattern on top of head completely and rather irregularly mottled with brown and tan, but mottlings not prominent (Figs. 4 and 5); scale rows 17-17-17 or 17-17-15, upper labials 6/6 or 7/7 (usually), lower labials 8/8 (usually) or 9/9; one preocular and two postoculars on each side.

Grant *et al.* (*op. cit.*: 132) noted that the prefrontal was single (fused) in one of the three then known specimens of *dolichurum*. In all



FIGS. 4-6. *Arrhyton dolichurum*, AMNH 77782, cliffs at San Vicente, Pinar de Río Province, Cuba, lateral and dorsal views of head, pattern at midbody.

other counts and measurements, the data of these authors are included within the ranges of the specimens above.

Distribution: known only from Cuba (Fig. 13). The restriction of the type locality by Grant *et al.* to La Habana is appropriate; the species is known to occur in the provinces of Pinar del Río, Habana, and Oriente, and is thus island-wide.

Remarks: The unusually low number of ventrals (125) in a female from La Habana (MBZH 2) is slightly below that of the lowest count (130) recorded by Grant *et al.* for the specimen from Santiago de Cuba.

The hemipenis of one male is partially extruded; proximally it is equipped with many tiny spinelets, and distally with a double crown of relatively long stout spines.

Specimens examined: CUBA, Pinar del Río Prov., cliffs at San Vicente (AMNH 77782); Cueva de los Indios, San Vicente (AMNH 77779); north base, Pan de Azúcar, 8 km E Matahambre (AMNH 81135); Habana Prov., Bosque de la Habana (MP 2).

Arrhyton vittatum Gundlach and Peters, 1862

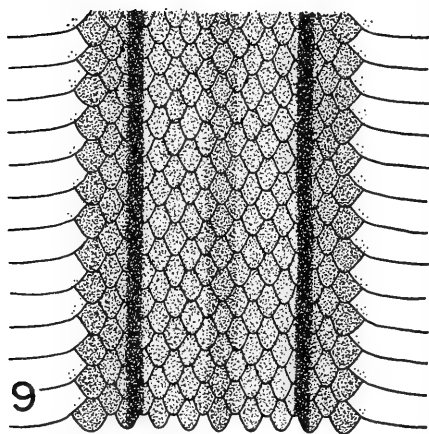
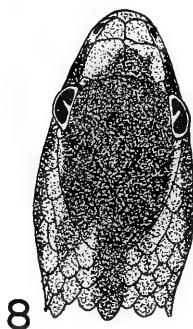
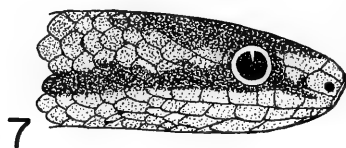
Carpodacus vittatus Gundlach and Peters, 1862, Monatsb. Akad. wiss. Berlin: 1003

Arrhyton bivittatum Cope, 1863, Proc. Acad. Nat. Sci. Philadelphia: 82

Arrhyton vittatum is an island-wide species, and occurs as well on the Isla de Pinos. By far the commonest of the three species, I have examined 50 specimens of this small snake. Study of this series shows that there are two subspecies involved. Since the type locality of *A. vittatum* is Cárdenas, Matanzas Province, Cuba, the nominate form occurs throughout most of Cuba, with the exception of the southern coast of Oriente, and the Isla de Pinos (Fig. 14), and may be defined as follows.

Arrhyton vittatum vittatum Gundlach and Peters, 1862

Description: A small, distinctly lined, non-glossy or iridescent, snake without a distinctly upturned rostral, ventrals 109–126 in males, 109–122 in females; subcaudals paired 52–57 in males, 52–66 in females; head not conspicuously flattened or broad; dorsal pattern a series of three dark brown longitudinal lines, the most lateral of which lie on scale rows 3 and 4, only very occasionally extending ventrally onto scale row 2 (Fig. 9); lined pattern not less pronounced in adults than juveniles; ventral surface dull cream in preservative and probably white in life; largest male, total length, 288 mm, tail, 95 mm; largest female, total length, 263 mm, tail, 84 mm; ratio of tail to total length, 32.5 (30.2–36.6) in males of all sizes, 31.0 (28.8–32.9) in all females; loreal present; prefrontals usually two, occasionally one; pattern on top of head a brown cap which is clearly delineated at its margin and involves the scutes including and posterior to the prefrontals and extends posteriorly variously to the edges of the parietals or beyond onto the



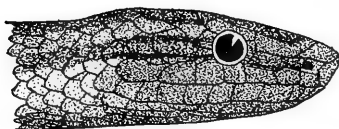
FIGS. 7-9. *Arrhyton vittatum vittatum*, MCZ 12362, Cojimar, Habana Province, Cuba, lateral and dorsal views of head, pattern at mid-body.

body scales (Figs. 7 and 8); median brown dorsal line (which usually involves the median and two paramedian dorsal scale rows) begins at the posterior edge of the cap and is usually joined to it; a brown loreal stripe courses from the naris through the eye and temporals, and thence posteriorly along scale rows 3 and 4, the temporal portion of this line distinct and separated from the brown cap by a fine pale line which extends from the posterior margin of the eye more or less along the outer edges of the parietals; of the three brown dorsal lines, the lateral pair is far darker than the middorsal line and is much more prominent in preserved specimens; some brown stippling or suffusion on the lower labials and the chin in general; scale rows 17-17-17, upper labials 7/7, lower labials 7/8, 8/8, or 9/9; one preocular and two postoculars (one snake has a single postocular unilaterally) on each side.

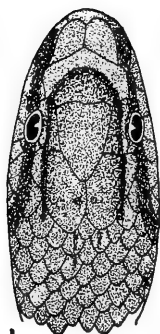
If total number of scales on the underside of each snake (ventrals + subcaudals) are totaled for each specimen, the entire series from Cuba (and not including the Isla de Pinos specimens) shows a range of 153 to 196 scales; excluding females (of which there are only eight), the total underbody scales in males varies from 171 to 196. The single Isla de Pinos specimen (MCZ 12447) on which both ventrals and subcaudals can be counted has a total count of 194 (119 ventrals + 75 subcaudals). No specimen from eastern Cuba (Pinar del Río or Habana provinces) has so high a total of underbody scales, and of the entire series of *v. vittatum*, only one individual (MCZ 10846—Matanzas Province) has a count equal to or exceeding this Isla de Pinos snake. The 75 subcaudals of the Isla de Pinos snake are remarkable (and result in the unusually high count for this individual) and only one other *v. vittatum* (USNM 139744—Banes, Oriente) has so high a subcaudal count. Likely more material from the Isla de Pinos would show that that island is inhabited by a distinct subspecies of *A. vittatum*; on the basis of two specimens, one of which has an incomplete tail, it is improvident to describe such a new race. I provisionally regard the Isla de Pinos as being inhabited by *Arrhyton v. vittatum* although I readily admit the lack of consonance of the Isla de Pinos material with that from Cuba itself.

Specimens examined: CUBA, Pinar del Río Prov., mountains north of San Vicente (AMNH 77780); Viñales (MP 263); Habana Prov., El Cotorro, 7 (AMNH 46723-28, MP unnumbered); Vedado (MCZ 44404); Cojimar (MCZ 12362); La Habana (USNM 93929); Jacomino (not mapped) (MP 527); Matanzas Prov., Finca San Matías, 9.5 km from Matanzas (MP 534); Río Hanábana, Ciénaga de Zapata (MCZ 10846); Las Villas Prov., Soledad, Cienfuegos, 6 (MCZ 7925, MCZ 12358, MCZ 22712, MCZ 32676, MCZ 34259-60); Sancti Spiritus (ANSP 15909); Sierra de Jatibonico (MCZ 7951); Sitiecito, Sagua la Grande (MP 184); Camagüey Prov., Martí, 7 (UMMZ 70889-93, UMMZ 72404-05); Oriente Prov., Banes, 3 (USNM 139742-44); San Germán (MP 212); Isla de Pinos, Santa Barbara, 2 (MCZ 12446-47).

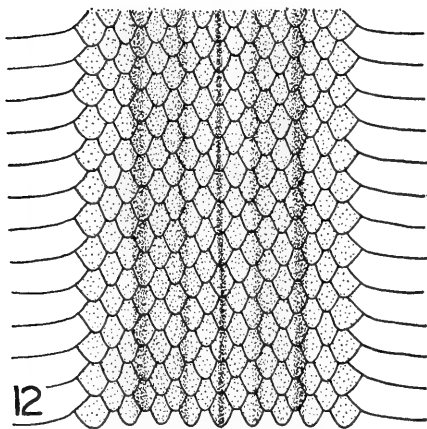
Specimens from the south coast of Oriente Province differ from *A.*



10



11



12

FIGS. 10-12. *Arrhyton v. landoi*, MCZ 42505, holotype, mountains north of Imías, Oriente Province, Cuba, lateral and dorsal views of head, pattern at midbody.

vittatum from elsewhere in Cuba. For this southern population, in recognition of Richard V. Lando's field work in this region, I propose the name

***Arrhyton vittatum landoi*, new subspecies**

Holotype: MCZ 42505, an adult male, mountains north of Imías, Oriente Province, Cuba, taken 25 July 1936 by P. J. Darlington.

Paratypes (all from Oriente Province, Cuba): AMNH 36703-04, Pilón, Ensenada de Mora, 25 May 1929, C. R. DeSola; AMNH 83584, 6.5 km S Palma Soriano, 11 July 1959, A. Schwartz; MCZ 42547, Cobre Range, Sierra Maestra, July 1936, P. J. Darlington; AMNH 2949, Santiago de Cuba, 1902-03, S. H. Hamilton; UIMNH 49303, Colonia España, Santiago de Cuba, 15 October 1945, Pastor Alayo Dalmau; MBZH 50-51, Guantánamo; MCZ 68724, Guantánamo Naval Base, June 1962, R. V. Lando; UIMNH 49301-02, Guantánamo Naval Base, December 1957, C. Grant.

Diagnosis: A subspecies of *A. vittatum* with higher ventral and subcaudal counts, higher tail/total length ratio, and reaching a larger size than *v. vittatum*.

Description of holotype: An adult male with the following data; total length 374 mm, tail 138 mm; ventral scales 150, subcaudal scales 102 plus terminal spine; prefrontal single, loreal present, preoculars 1/1, postoculars 2/2, upper labials 7/7, lower labials 9/9, scale rows 17-17-17; tail/total length ratio 36.9.

Dorsum with tan with a pair of lateral lines on scale rows 3 and 4 (Fig. 12); median dorsal line faint; venter immaculate cream; brown cap obsolete, rather hollowed centrally and with sharply defined edges, surrounded by a pale tan figure from the posterior border of the parietals through and above the eye onto the prefrontal; a brown (but paler centrally) stripe across the lores through the eye and across the temporals and continuing as the lateral stripe on the body; lower labials and chin stippled rather heavily with brown (Figs. 10 and 11).

Variation: The series of *landoi*¹ is composed of nine males (including

¹ Since the present manuscript was completed, two additional specimens of *Arrhyton v. landoi* were procured at the United States Naval Base, east side of Guantánamo Bay, south versant of Paul Jones Mountain, at approximately 300 feet, by Richard Thomas on 23 April 1965. These specimens have the following data: 1) ASFS (Albert Schwartz Field Series) V6233, male, total length 366 mm, tail 128, tail/total length ratio 35.0; ventrals 144, subcaudals 92, total underbody scales 236; 2) ASFS V6234, female, total length 382 mm, tail 132, tail/total length ratio 34.6; ventrals 140, subcaudals 94, total underbody scales 234. The female (like MCZ 42547) has two loreals on one side. These two specimens were collected in a rotting mat of palm fibers about the base of a fan palm in a palm thicket on a xeric, scrubby hillside. They agree completely in color and pattern with *A. v. landoi*, and agree as well in meristic data. The female is the largest *landoi* of either sex; this specimen likewise has two more ventrals (140) than is reported above for this sex. Since the female also has a complete tail, the tail/total length ratio of 34.6, when combined with that of the single female noted above, gives a range of 33.6 to 34.6. These two additional specimens are to be regarded as paratypes of *A. v. landoi*.

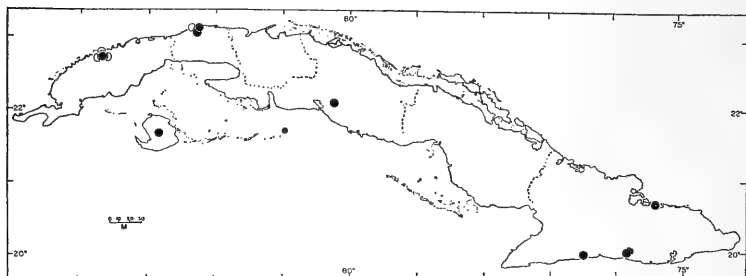


FIG. 13. Map of Cuba and the Isla de Pinos, showing localities whence specimens have been examined; solid circles, *A. taeniatum*; open circles, *A. dolichurum*. The latter species occurs also in the vicinity of Santiago de Cuba.

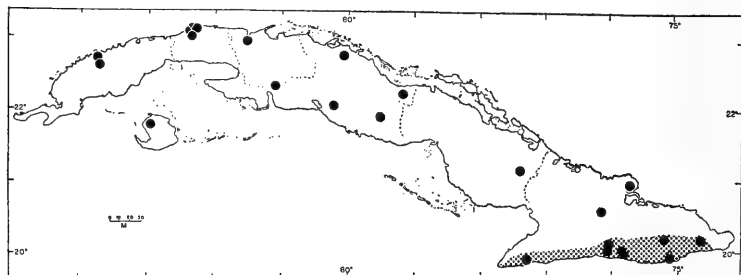


FIG. 14. Map of Cuba and the Isla de Pinos, showing localities whence specimens of *A. vittatum* have been examined; shaded area is range of *A. v. landoi*, remainder of dots indicate range of *A. v. vittatum*.

the holotype) and three females. All specimens have 1/1 preoculars and 2/2 postoculars, all but one have the lateral line on scale rows 3 and 4 (exception, on scale row four only—UIMNH 43901), all but one have 17-17-17 scale rows (exception, 16-17-17—AMNH 2949). The pre-frontals are double in six specimens, single in three, and incompletely fused in one (AMNH 2949); loreals are 1/1 in all but one individual with 2/1 (MCZ 42547). The ventrals in males vary between 118 and 150 (mean, 127.8), in females between 124 and 138 (mean, 131.0); subcaudals in males vary between 71 and 111 (mean, 87.4). Only one female has a complete tail with 69 subcaudals; two females with incomplete tails have at least 63 and 80 subcaudals, the latter being probably about three scales shy of the complete complement. The largest male has a total length of 374 mm, with a tail of 138 mm (the type);

the largest female measures 323 mm with a tail of 100 mm, the tail being incomplete and the total length thus not a reliable figure. Tail/snout-vent length ratios of all males with total lengths in excess of 270 mm (seven specimens) vary between 33.8 and 39.2 (mean, 37.1); the same ratio for the single female with a complete tail is 33.6. Total number of underbody scales for the entire series ranges from 193 to 252; with the single female excluded, the range is 196 to 252.

Since several of the specimens of *A. v. landoi* are no longer available to me, I cannot discuss variation in coloration in any detail. From the eleven that are at hand, the following information can be drawn. The hollowed brown cap occurs not only in the holotype but in two other specimens (MCZ 42505, MCZ 68724); the remainder of the specimens have the black cap solid brown. The middorsal line is thin (as in the type) in four specimens and wider and heavier in the balance; the broader line seems to be more typical of *A. v. vittatum* than of *landoi*, although in the nominate form it is likewise variable. There is in *landoi* a stronger tendency for the lower labials and chin to be spotted than in *v. vittatum*.

Comparisons: When Dr. Williams first suggested my working on this interesting lot of *Arrhyton* from southern Oriente, he was convinced that some of these specimens represented either a new subspecies of *A. dolichurum* or an undescribed species. After having studied the material (but being limited by several factors such as the few specimens available and the inaccessibility of others) I am still not completely certain that some of these specimens do not represent a new species. I reject the proposal that the south Oriente material is a subspecies of *A. dolichurum*. *A. dolichurum* is a much larger, iridescent snake, stockier in build, and with a distinctly different pattern. The species *dolichurum* and *vittatum* resemble each other in having a loreal, the lateral stripes on scale rows 3 and 4, and having usually two prefrontals. The tail/total length ratios of *dolichurum* and *v. vittatum* (males in both cases) do not overlap, whereas the tail/total length ratio of *v. landoi* partially bridges the gap but overlaps that of *v. vittatum* rather than that of *dolichurum*. In ventral scales, the counts of male *landoi* are nicely intermediate between *v. vittatum* and *dolichurum*. The same is not true with subcaudals, where those of *landoi* overlap the counts for *v. vittatum* but not those of *dolichurum*. The result of these comparisons indicates to me that *landoi* is closer to *vittatum* in size, pattern, and number of subcaudals than to *dolichurum*.

A. v. landoi differs from *A. v. vittatum* in higher number of ventrals (male *vittatum* 109–126, male *landoi* 118–150), higher number of subcaudals (male *vittatum* 52–75, male *landoi* 71–111), higher total number of underbody scales (male *vittatum* 171–196, male *landoi* 196–252), higher tail/total length ratio (adult male *vittatum* with total length above 230 mm, 32.3 (28.3–34.6), adult male *landoi* with total lengths above 270 mm, 37.1 (33.8–39.2), and longer total length in *landoi* (*vittatum* males to 288 mm, *landoi* males to 374 mm). Although there

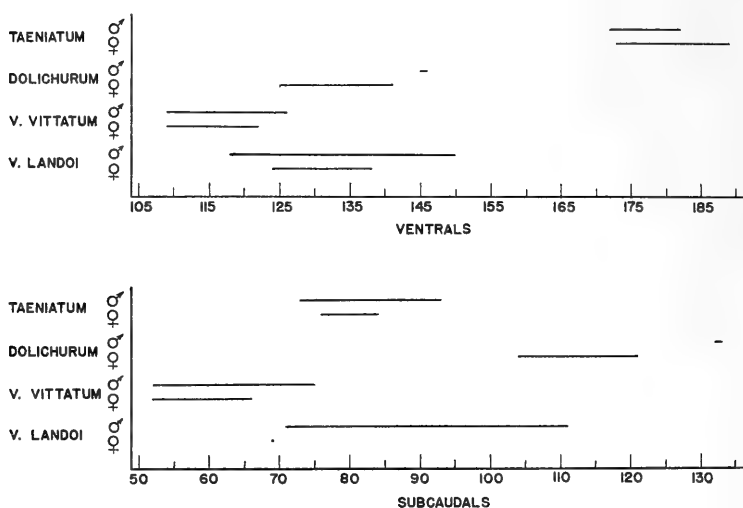


FIG. 15. Distribution of number of ventrals and subcaudals in four populations of *Arrhyton*.

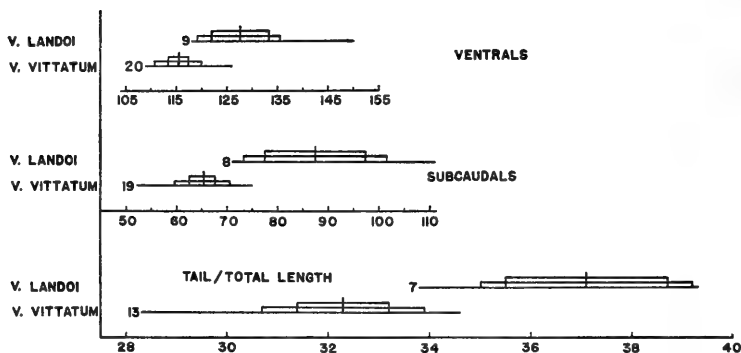


FIG. 16. Number of ventrals, subcaudals, and tail/total length ratio in two populations of *A. vittatum*; low rectangles equal one standard deviation, high rectangles equal two standard errors of the mean. In computing the ratio, only males of *landoi* in excess of 270 mm and of *v. vittatum* in excess of 230 mm (*i.e.*, adults) were employed. All data for Figure 16 apply only to males, since females are less well represented in collections.

are less females than males of both subspecies, the females show the same general relationship of *vittatum* to *landoi* as do the males.

Comparison of *landoi* with *dolichurum* was made above. *Landoi* differs from *taeniatum* in size (*taeniatum* being much the larger and more robust snake), in having a loreal which *taeniatum* lacks, in having the lateral lines on scale rows 3 and 4 rather than on 4 to 6 in *taeniatum*, and in having less ventrals. The tail/total length ratio is greater in *landoi* than in *taeniatum*.

The holotype of *Arrhyton bivittatum* Cope (USNM 5784) was examined for me by Dr. Cochran; there was a possibility that this specimen might be assignable to the southern Oriente race. However, 111 ventrals, 55 subcaudals, and a tail/total length ratio of 28.8 clearly indicate that *bivittatum* (type locality—"Cuba") is a synonym of *A. v. vittatum*.

Remarks: The range of *A. v. landoi* lies principally in and to the south of the series of massifs which parallel the south Oriente coast—the Sierra Maestra—Sierra de Gran Piedra—Sierra de Purial system (Fig. 14). The type locality presumably is in the latter range, and there is another specimen from the Cobre Range which is part of the Sierra Maestra system. The specimen from south of Palma Soriano is from the lower eastern portion of the Sierra Maestra. Much of the region embraced by the range of *landoi* is extremely xeric, since the southern Oriente coast lies within the rain shadow of the mountains to the north. The Sierra de Purial itself is a rather dry mountain range as well. However, since the subspecies has been collected in the Sierra Maestra (including the Cobre Range), it appears to occur at least at lower elevations in these more mesic highlands.

There is no evidence of intergradation between *v. vittatum* and *v. landoi*. A single female from San Germán, which lies to the north of the Sierra Maestra and north of the Río Cauto, has 115 ventrals and 64 subcaudals, and in these counts is no nearer *landoi* than, for example, specimens from Martí, Camagüey, or various Las Villas localities.

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PROCEEDINGS
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NOMENCLATURE AND TAXONOMIC POSITION OF
PSEUDOSPORIDAE, VAMPYRELLIDAE AND
ACINETACTIDAE

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Confusion about the taxonomic position of the helioflagellates and other rhizopods has resulted from the deficiency of knowledge about the nature of their pseudopodia and other characteristics. As a result, widely differing organisms have often been grouped together. The subclass Proteomyxidia Levine and Corliss (1963) is an example of such an unnatural group. In a recent classification of the phylum Protozoa (Honigberg *et al.*, 1964) the subclass Proteomyxidia Levine and Corliss (1963) includes the families Vampyrellidae Zopf (1885) and Pseudosporidae Kent (1881), but the type genera of these families have few features in common.

Pseudospora volvocis Cienkowski (1865) was designated by Poche (1913: 197) as the type species of *Pseudospora*. The overall appearance of the amoeboid form and the character of the nucleus as well as the general construction of the flagellated forms of *Pseudospora volvocis* led Roskin (1927) to state that a close relationship exists between *Pseudospora* and *Naegleria*, a member of the family Tetramitidae Kent (1881), order Amoebida Ehrenberg (1830), according to Loeblich and Tappan (1961). Hawes and Lytle (1964) discovered a new polymorphic rhizopod associated with a colonial hydroid from brackish water areas which appears to be closely related to *Pseudospora* or even may be a new species of that genus. This organism and its relatives are stated not

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to be related to the Heliozoia; the resemblance is only superficial.

For *Vampyrella* Cienkowski (1865) a type has not previously been designated. Hence *V. spirogyrae* Cienkowski (1865: 218), a junior synonym of *V. lateritia* (Fresenius) Leidy (1879: 253), basionym *Amoeba lateritia* Fresenius (1858: 218), is here designated as the type-species of the genus.

Pseudosporidae shows a close relationship to Tetramitidae [Amoebida], but *Vampyrella* shows certain similarities of body form and method of movement with the subclass Heliozoia Bütschli, 1881. These similarities led Leidy (1879) to call *Vampyrella lateritia* "Actinophrys-like." Nevertheless the absence of axopodia in *Vampyrella* prevents its placement in one of the present three orders of the Heliozoia. We refer the genus *Vampyrella* and the family Vampyrellidae Zopf (1885) to the order Vampyrellida West (1901) and place them in the subclass Heliozoia Bütschli (1881).

The subclass Proteomyxidia Levine and Corliss (1963) is therefore an unnatural group, since the two families in it show a closer resemblance to other groups than to each other. This grouping should be abandoned, and the organisms previously included in it should be placed elsewhere.

In the above mentioned classification of Honigberg *et al.* (1964) certain errors in cited rank and authorship require comment. Proteomyxidia was first used as a subclass by Delage and Hérouard (1896) and should not be credited to Levine and Corliss (1963). The Proteomyxida was not used by Lankester (1885) as an order but as a class. Chatton (1925) was the first to use it as an order, hence he is the correct author, rather than Lankester.

In the classification system mentioned above (Honigberg *et al.*, 1964) the helioflagellates are placed in the class Zoomastigophorea Calkins (1909), order Rhizomastigida Doflein (1916). In footnote 7, page 11, of the same paper, the order Rhizomastigida is stated to be a polyphyletic group. The resemblance between the helioflagellates and the order Centrohelida of the subclass Heliozoia is also noted. Because of the possession of axopodia and the report of a central granule in some members (Bělař, 1926, Gruber, 1881, Leidy, 1879, and Valkanov, 1928) the helioflagellates should be removed from the order Rhizomastigida and placed among the subclass Heliozoia. The use of the invalid family name Helioflagellidae and the generic name *Dimorpha* (later homonym of five genera) by the recent classification system (Honigberg *et al.*, 1964) are nomenclaturally incorrect.

The family name Helioflagellidae Doflein (1916) is invalid because it is not based on the name of an included genus (International Code of Zoological Nomenclature, Art. 29) and is synonymous with Acinetactidae Stokes (1886). The previously ignored family Acinetactidae, based on *Acinetactis* Stokes (1866) is the correct name for this group of organism.

Valkanov (1926) described a new helioflagellate genus, but he spelled the generic name *Dimorphiella* (p. 106, 120), *Dimorptriella* (p. 106), and *Dimorptiella* (p. 119). In 1928 (p. 442), he used a fourth spelling *Dimorphella*. *Dimorphiella* Valkanov (1926) is here chosen as the correct original spelling.

Bovee (1960) says, "There is, I believe, not sufficient evidence to validate Valkanov's dichotomy of the genus *Dimorpha* nor the establishment, therefore, of the genus *Dimorphella*" (p. 511), and he gives ample evidence for his statement. *Dimorphiella* Valkanov (1926) should therefore be considered a synonym of *Dimorpha* Gruber (1881). But since *Dimorpha* Gruber (1881) is a junior homonym of the following: *Dimorpha* Jurine (1807); *Dimorpha* Huebner (1822); *Dimorpha* Gray (1840); *Dimorpha* Hodgson (1841) and *Dimorpha* Courtiller (1861), the generic name is here replaced by its oldest synonym, *Dimorphiella* Valkanov (1926). *Tetradimorpha* with one included species, *T. radiata*, is superfluous for ***Dimorphiella tetramastix*** (Penard) new combination. The following new combinations (boldface) are necessary: ***Dimorphiella mutans*** (Gruber) basionym *Dimorpha mutans* Gruber (1881: 447); ***Dimorphiella tetramastix*** (Penard), basionym *Dimorpha tetramastix* Penard (1921: 111), synonym *Tetradimorpha radiata* Hsiung (1927: 208); ***Dimorphiella monomastix*** (Penard), basionym *Dimorpha monomastix* Penard (1921: 116); ***Dimorphiella flordianis*** (Bovee), basionym *Dimorpha flordianis* Bovee (1960: 504).

The family Acinetactidae Stokes (1886) includes the two genera *Acinetactis* and *Dimorphiella*, and is placed in the subclass Heliozoia Bütschli (1881) order Centrohelida Kühn (1926). Other genera previously placed in the invalid Helioflagellidae, but not here included in the Acinetactidae, are considered by many workers (Fott, 1959 and Valkanov, 1928) to belong to the class Chrysophyceae Fritsch *in* West and Fritsch (1927).

The family Acinetactidae is characterized as follows: The organisms either have two stages of which one has axopodia and the other has two or four flagella but no axopodia, or they have a single stage with both axopodia and two flagella. *Acinetactis* includes those organisms with only one stage, and *Dimorphiella* includes organisms with alternating stages. Many workers report a central granule and also granules on the axopodia.

We would like to thank Drs. G. F. Papenfuss, Helen Tappan and A. R. Loeblich, Jr. for critical reading of the manuscript.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF BLIND SNAKE, *TYPHLOPS*,
FROM TRINIDAD

BY NEIL D. RICHMOND

Carnegie Museum, Pittsburgh, Pennsylvania

In the American Museum Collection of Neotropical *Typhlops* there is one specimen from Trinidad that is distinctively different from any now known from the New World. I wish to express my appreciation to Charles M. Bogert and Richard G. Zweifel of the American Museum of Natural History for the loan of specimens in their care and for their permission to study and report on this new form. I also want to thank Albert Schwartz for the opportunity to study a specimen of *T. caymanensis* Sackett and Ernest E. Williams of the Museum of Comparative Zoology for the loan of two specimens of *T. lehneri* Roux.

***Typhlops trinitatus*, new species**

Holotype: AMNH 89820, from Trinidad, "in log beside Arima Road, 3 miles above Simla." Collected by James A. Oliver and John Tee-Van, 1 April 1956.

Diagnosis: A distinctively patterned species of *Typhlops* with rows of brown dots on a yellow background, yellow snout and tail, scales in 20 rows around the body and 389 in the mid-dorsal series. The preocular is in contact with upper labials two and three. The combination of high number of mid-dorsals, 20 scale rows and preocular in contact with two labials is shared by only two other *Typhlops* in the New World: *T. caymanensis* and the recently described *T. costaricensis* Jiménez and Savage. From these it differs in color and in the following details of head scutellation. The fourth upper labial is very large in *costaricensis*, much higher than long and extends up the posterior margin of the ocular; in *caymanensis* the fourth supralabial is longer than high and is more than twice as long as the third supralabial; in *trinitatus* the third and fourth supralabial are similar in size and shape and are both higher than long. Of these forms *trinitatus* is the only one with the eye situated under the ocular-preocular suture.

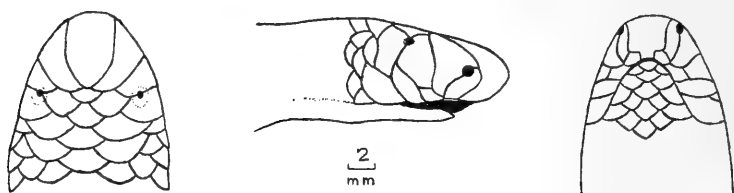


FIG. 1. *Typhlops trinitatus*, AMNH 89820, Trinidad, dorsal, lateral, and ventral views of head.

T. trinitatus is most closely related to *lehneri* of Venezuela. Both have strongly depressed muzzles and a similar color pattern except that the dorsal color continues to the tip of the tail in *lehneri*, the entire head from behind the eyes is unpigmented in *lehneri* while just the rostral and nasals are unpigmented in *trinitatus*. Details of head scutellation and position of eye appear to be the same. The important difference between the two forms is the high number of mid-dorsal scales in *trinitatus*. In a series of 19 *lehneri*, Shreve (1947, Bull. Mus. Comp. Zool., Harvard, 99 (5): 512-517) found the number of mid-dorsals to range from 289-332. He also gave lengths of the largest specimen; 185 mm and the longest gravid female; 170 mm so it is apparent that *trinitatus* is a much larger species as the one specimen available is approximately 240 mm long.

From *T. reticulatus* (Linn.) it differs in having a complete nasal suture and in much higher number of mid-dorsal scales, *reticulatus* has less than 300, average 235.

Description: Head not tapering but broadly rounded with muzzle strongly depressed. Rostral wide, its width almost half that of head, does not extend posteriorly to a line connecting the anterior margin of the eyes; nasals completely divided by a suture that extends from the upper labials through the nostril to the rostral. The suture is a continuation of the suture between labials one and two. The preocular is almost triangular in shape with the apex directed upward. At the level of the eye it is narrower than the posterior nasal, at its base it is broadly in contact with upper labials two and three. Ocular higher than wide, the ocular-preocular suture almost straight, the eye is visible, on dorso-lateral surface of head and is located under the ocular-preocular suture near the upper end of these scales; one pair of enlarged parietals each approximately as wide as two body scales; one postocular; four upper labials, third and fourth largest with the fourth only slightly larger than the third. 389 mid-dorsal scales. Scales around body are in 20-20 rows. The three counts are anterior, midbody, and preanal respectively.

Color: Snout and tail yellow, as are 9 ventral rows of scales. Dorsum

same color as venter except that the center of each scale has a dark brown round to squarish spot giving an appearance of 11 lines of dots.

Remarks: Most of the Antillean species of *Typhlops* have the preocular in contact with only the third upper labial, the two exceptions are *caymanensis* and *biminiensis* Richmond in which the preocular is in contact with upper labials two and three. In this respect these two species resemble most of the South and Central American forms.

The only other *Typhlops* known from Trinidad is *reticulatus* which has an incomplete nasal suture and less than 300 mid-dorsal scales.

The genus *Typhlops* is represented in South America and its detached fragment, Trinidad, by five species. These and their ranges as currently known are: *lehneri*, Venezuela; *unilineatus* (Dumeriland Bibron), Surinam (Dutch Guiana); *lumbricalis* (Linn.), British Guiana; *reticulatus*, Tropical South America, east of the Andes; and the present species, *trinitatus* from Trinidad.

Two species, *lehneri* and *unilineatus*, have limited ranges, *lumbricalis* may be an introduction from the West Indies as it is widespread in the Caribbean Islands but known only from British Guiana on the continent. The range of *reticulatus* extends from northern Argentina to Trinidad and from eastern Brazil to Peru.

Although Emsley (1963, Copeia: 576-577) questions the presence of *reticulatus* on Trinidad, there are two specimens; AMNH 64467 (2) labeled "Trinidad, Tucker Valley." These appear to be the only specimens of this species known from the island. In number of mid-dorsal scales (210 and 216) they are lower than the average (235) for *reticulatus*. Both of these specimens are uniform dark brown above gradually fading on the sides to white below (yellow in life?), the light ventral color occupies seven rows of scales. The scale rows around the body are 20-20-20, the nasals are incompletely divided and the head scutellation agrees with that of *reticulatus*.

KEY TO SPECIES OF *Typhlops* CURRENTLY KNOWN FROM SOUTH AMERICA

1. No preocular; 26-28 scale rows *unilineatus* (Dutch Guiana)
Preocular present; 20 scale rows at midbody 2
2. Preocular in contact with upper labial three only
..... *lumbricalis* (British Guiana)
Preocular in contact with upper labials two and three 3
3. Nasal suture incomplete, does not contact rostral
..... *reticulatus* (South America E of Andes)
Nasal suture complete, contacts rostral 4
4. Mid-dorsal scales 389, tail yellow *trinitatus* (Trinidad)
Mid-dorsal scales 289-332, tail same color as dorsum
..... *lehneri* (Venezuela)

PROCEEDINGS
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TAXONOMIC STATUS OF THE SNOWSHOE
RABBIT, *LEPUS AMERICANUS SECLUSUS*
BAKER AND HANKINS

BY CHARLES A. LONG

Department of Zoology, University of Illinois, Urbana

In the year 1950, Baker and Hankins (Proc. Biol. Soc. Washington, 63: 63, May 25) named and described a subspecies of snowshoe rabbit from the Bighorn Mountains, Wyoming. They named this subspecies *Lepus americanus seclusus* and mentioned its several diagnostic characters. The type is Univ. Kansas 20897, from 12 miles east and two miles north of Shell, 7,900 ft, Bighorn Mountains, Big Horn County, Wyoming.

Baker (J. Mamm., 40: 145, 1959) subsequently published the following: "Henry W. Setzer has kindly called my attention to the fact that *Lepus americanus seclusus* Baker and Hankins . . . is preoccupied by *Lepus timidus seclusus* Degerbøl, 1940. As a substitute, I propose *Lepus americanus setzeri*."

It is not surprising that Setzer considered Degerbøl's name a homonym of *seclusus* Baker and Hankins, although Degerbøl's name pertains to a "variety" or "forma." In North America variety has often been used interchangeably with the word subspecies. Degerbøl's "variety" definitely does not mean subspecies, for he expressly states that his population is not a subspecies but is probably instead a phenotypic variant for which the term variety is used (Zoology of the Faeros, Mammalia. Copenhagen, 1940).

According to the International Code of Zoological Nomenclature (1964: 45), "infrasubspecific forms are excluded from the species-group and the provisions of this Code do not apply to them. . . . The original status of any name of a

taxon of lower rank than species is determined as . . . infrasubspecific, if the author, when originally establishing the name, either expressly referred the taxon to an infrasubspecific rank, or, after 1960, did not clearly state that it was a subspecies." Degerbøl expressly referred the taxon to an infrasubspecific rank, and the name combination *Lepus timidus seclusus* Degerbøl, 1940, is not covered by the provisions of the Code.

Article 17(9) of the Code states that a name is or remains available even though before 1961, it was proposed as a "variety" or "form." However, article 10(b) tells how and when an infrasubspecific name, such as *seclusus* Degerbøl, becomes available: "A name first established with infrasubspecific rank becomes available if the taxon in question is elevated to a rank of the species-group, and takes the date and authorship of its elevation." Degerbøl's name has not been so elevated, and if it were, although made available, unless elevated before the date of Baker and Hankin's name (1950) Degerbøl's name would be an invalid homonym.

Lepus americanus seclusus Baker and Hankins, 1950, therefore, is or was not preoccupied by Degerbøl's name, and remains the valid and available name for the relict population of *Lepus americanus* in the Bighorn Mountains. *Lepus americanus setzeri* is a junior synonym of *L. a. seclusus*. I thank Professor E. Raymond Hall, University of Kansas, and Professor Hobart M. Smith, University of Illinois, for advice and information.



PROCEEDINGS
OF THE
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TWO NEW SPECIES OF *ARICIDEA* (POLYCHAETA,
PARAONIDAE) FROM VIRGINIA AND FLORIDA, AND
REDESCRIPTION OF *ARICIDEA FRAGILIS* WEBSTER

BY MARIAN H. PETTIBONE

This study of paraonid polychaetes is based, for the most part, on material from two sources: two species from Chesapeake Bay, off Eastern shore, Virginia, collected by Dr. Marvin L. Wass of the Virginia Institute of Marine Science, and two species from the Gulf of Mexico, Seahorse Key, Cedar Keys, Florida, collected by Mr. John L. Taylor of the Fish and Wildlife Service, St. Petersburg Beach, Florida. One new species of *Aricidea* from each collection is described, and I have taken this opportunity to supplement the descriptions of two of the previously known species of that genus, including that of the type-species, *Aricidea fragilis* Webster.

The following material of *Aricidea* (*Aricidea*) is described:

- A. fragilis* Webster from North Carolina,
South Carolina, and Florida
- A. taylori*, new species from Florida
- A. jeffreysii* (McIntosh) from Virginia
- A. wassi*, new species from Virginia

This study was aided in part by a grant from the National Science Foundation (NSF GB-1269).

Family PARAONIDAE Cerruti
Genus *Aricidea* Webster, 1879

Type species: *A. fragilis* Webster, 1879; by monotypy. Gender: feminine.

Diagnosis: Body long, slender, threadlike, cylindrical, composed of numerous segments. Prostomium subconical, with dorsal median antenna and pair of nuchal slits. First or buccal segment achaetous, more or less fused with prostomium and ventrally forming lateral lips of mouth. Ventral part of first two setigerous segments forming a posterior lip.

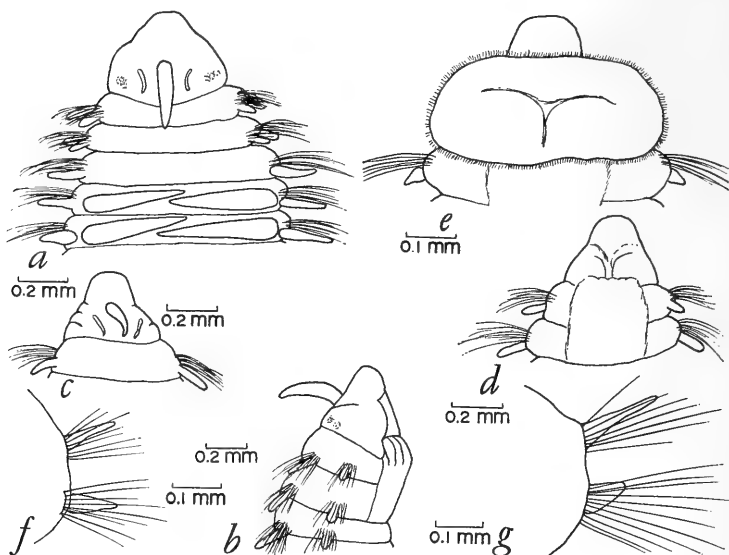


FIG. 1. *Aricidea fragilis*: a, Dorsal view anterior end; b, lateral view anterior end of another specimen; c, dorsal view anterior end of another specimen; d, same, ventral view; e, ventral view anterior end of specimen with ciliated, globular proboscis extended; f, parapodium from setiger 1; g, same, from setiger 2.

Parapodia biramous, lacking distinct setal lobes, having simple smooth capillary setae, with digitiform to filiform postsetal notopodial lobes (sometimes referred to as dorsal cirri), and with or without postsetal neuropodial lobes on some anterior segments (sometimes referred to as ventral cirri). Branchiae simple, paired, straplike, ciliated, dorsal to notopodia and turned medially on dorsum, absent from few anterior segments (3–5) and from long posterior region (6 to 60 pairs of branchiae). Pygidium with 2–3 filiform anal cirri. Anterior end of digestive tube evaginable as a cylindrical, globular, or feebly lobed proboscis.

Subgenus *Aricidea*

Diagnosis: With only capillary setae in notopodia, without modified setae in some posterior notopodial segments. With or without modified setae in posterior neuropodia (crochets, acicular setae or setae with mucronate tips).

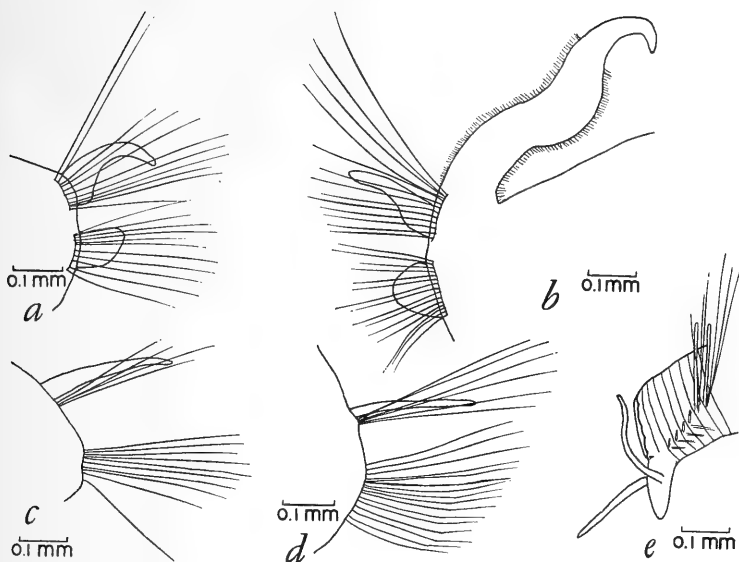


FIG. 2. *Aricidea fragilis*: a, Parapodium from setiger 3; b, same, from middle branchial segment; c, same, from anterior postbranchial segment; d, same, from posterior postbranchial segment; e, lateral view posterior end.

Aricidea (Aricidea) fragilis Webster

Aricidea fragilis Webster, 1879: 255, Pl. 9, Figs. 127–132.—Hartman, 1944: 315, Pl. 27, Figs. 4, 5; 1945: 30, Fig. 3; 1957: 317, Pl. 43, Fig. 3.—Not McIntosh, 1885: 354 (perhaps = *A. albatrossae* Pettibone, 1957: 354).—Not Fauvel, 1936: 65 (= *A. fauveli* Hartman, 1957: 318).

Material examined: FLORIDA, Seahorse Key, Cedar Keys, John L. Taylor, coll., 1960: West Lagoon, March 5 (9 spec.), Gardners Point, sand, September 9 (6 spec.), West Point, silty sand, October 9 (8 spec.). SOUTH CAROLINA, off dock, Bears Bluff Laboratories, Wadmalaw Island, 24 March 1961, G. Robert Lunz, coll. (1 spec.). NORTH CAROLINA, Beaufort, 1951, Evelyn Cole, coll. (18 spec.).

Description: Length to 100 mm, width to 2 mm, segments to 300. Body long, slender, subcylindrical, widest and flattened dorsoventrally in branchial region, tapering gradually posteriorly. Prostomium and achaetous buccal segment fused, subcordiform, widest posteriorly, rounded anteriorly, variable in shape; median antenna short, subulate, extending at most to setiger 2; pair of nuchal slits lateral to antenna;

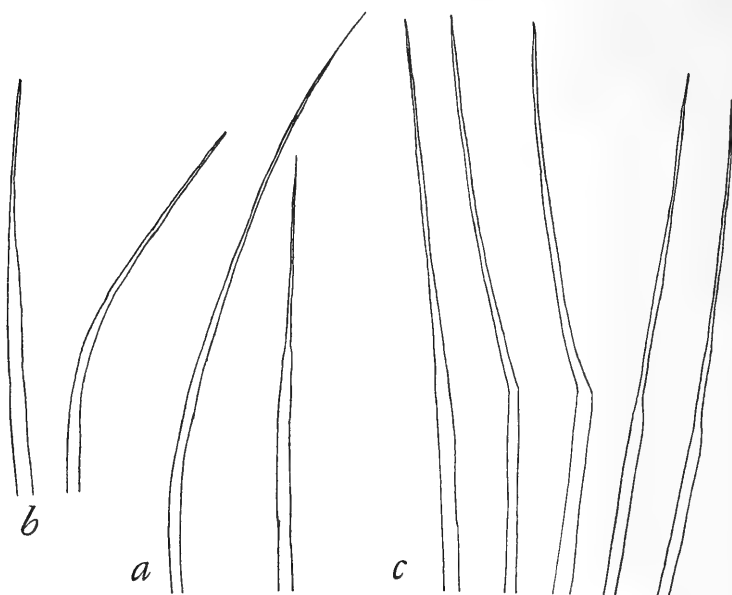


FIG. 3. *Aricidea fragilis*: a, Notosetae from branchial segment; b, neurosetae from branchial segment; c, neurosetae from posterior post-branchial segment.

sometimes with pigmented areas lateral to nuchal organs (Fig. 1, a, b; referred to as eyes by Webster); pair of deep-set small eyes anteriorly (usually not visible when preserved). Lateral lips of mouth formed by achaetous buccal segment (fused to prostomium); ventral area of first two setigerous segments forming posterior lip of mouth (no separate achaetous segment as shown by Hartman, 1944, Pl. 27, Fig. 4). When extended, proboscis a short, bulbous, ciliated sac (Fig. 1, e).

Branchiae beginning on setiger 4, 50–60 pairs, nearly covering dorsum in branchial region. Notopodial postsetal lobes (= dorsal cirri of Webster) short, digitiform on first two setigers (Fig. 1, f, g), longer and wider basally on setiger 3 (Fig. 2, a) and on branchial setigers (Fig. 2, b), digitiform to filiform on postbranchial setigers (Fig. 2, c, d). Neuropodial postsetal lobes (= ventral cirri of Webster) subequal in length to notopodial postsetal lobes on first setiger; shorter, conical to oval from setiger 2 to about setiger 40; absent from about setiger 40 posteriorly. Notosetae of anterior segments forming thick bundles; notosetae long, simple, thickened basally, tapering to capillary tips (Fig. 3, a); posterior notopodial bundles composed of few (4–8), delicate, capillary notosetae. Neurosetae similar to notosetae in anterior region

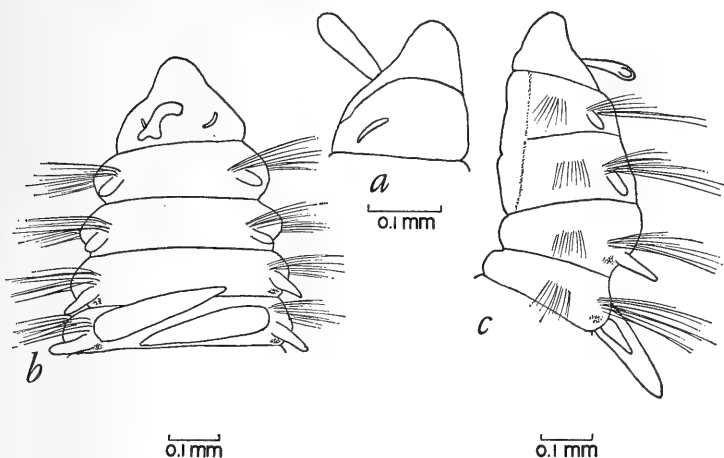


FIG. 4. *Aricidea taylori* new species: a, Lateral view anterior end of holotype; b, dorsal view anterior end paratype with bifid antenna; c, same, lateral view.

(Fig. 3, b); ventral neurosetae of posterior region stouter basally, tapering rather abruptly about midlength, sometimes partially or completely fracturing at this midpoint (Fig. 3, c; referred to as pseudoarticulate setae by Hartman). Pygidium a conical ventral lobe with pair of lateral, filiform anal cirri; anus subterminal and dorsal (Fig. 2, e).

Distribution: Chesapeake Bay (off Eastern shore, Virginia) to Gulf of Mexico (Cedar Keys, western Florida), low intertidal, in mud and silty sand.

***Aricidea (Aricidea) taylori*, new species**

Material examined: FLORIDA, Seahorse Key, Cedar Keys, West Lagoon, in silty sand, 5 March 1960, John L. Taylor, coll. (mixed with *Aricidea fragilis* Webster). The types are deposited in the United States National Museum, holotype USNM 31494, three paratypes USNM 31495.

Description: Length to 30 mm, width to 0.5 mm, segments to 180 (smaller and slenderer than *A. fragilis*). Body long, slender, subcylindrical, widest and flattened dorsoventrally in branchial region, tapering gradually posteriorly. Prostomium and achaetous buccal segment fused, subcordiform, widest posteriorly, rounded anteriorly; median antenna short, extending at most to first setiger, clubbed (one paratype with distal tip bifid, evidently an anomaly, Fig. 4, b, c); pair of nuchal slits lateral to antenna. Lateral lips of mouth formed by achaetous

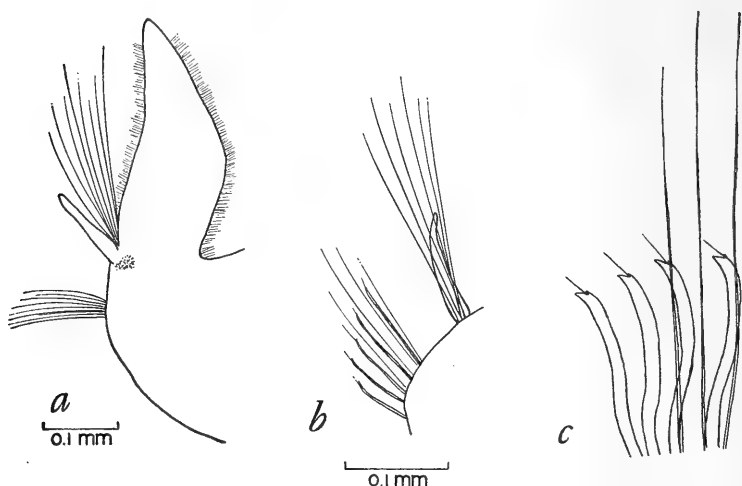


FIG. 5. *Aricidea taylora* new species: a, Parapodium from branchial segment; b, parapodium from posterior postbranchial segment; c, neurosetae from same, enlarged.

buccal segment (fused to prostomium); ventral area of first two setigerous segments forming posterior lip of mouth.

Branchiae beginning on setiger 4, about 28 pairs (26–29), thicker basally, gradually tapering distally, ciliated except for distal tips. Notopodial postsetal lobes short, cylindrical on first two setigerous segments, longer, subulate on setiger 3 and on branchial setigers, becoming filiform on postbranchial setigers. Neuropodial postsetal lobes absent. Notopodia and neuropodia with thick bundles of setae in several rows in anterior prebranchial and branchial setigers; notosetae and neurosetae thickened basally, tapering to capillary tips; notopodia of postbranchial setigers with small bundles of notosetae composed of few (about 7), slender, capillary notosetae; anterior postbranchial neuropodia with bundle of about 10 capillary setae and 2 hooks (hooks beginning on about setiger 35); posterior neuropodia bearing neurosetae of two kinds: few (3–4), long, slender, capillary neurosetae, and few (4–6) bidentate hooks with slender aristae emerging from notch between teeth. Pygidium subconical, with pair of lateral, filiform anal cirri. Color (preserved): yellowish, with reddish pigmented areas in bases of notopodia of branchial segments.

Distribution: Gulf of Mexico (Cedar Keys, western Florida), low intertidal, in silty sand.

Remarks: Of the species of *Aricidea* (*Aricidea*) which lack neuropodial postsetal lobes, *A. taylora* resembles most closely *A. brevicornis*

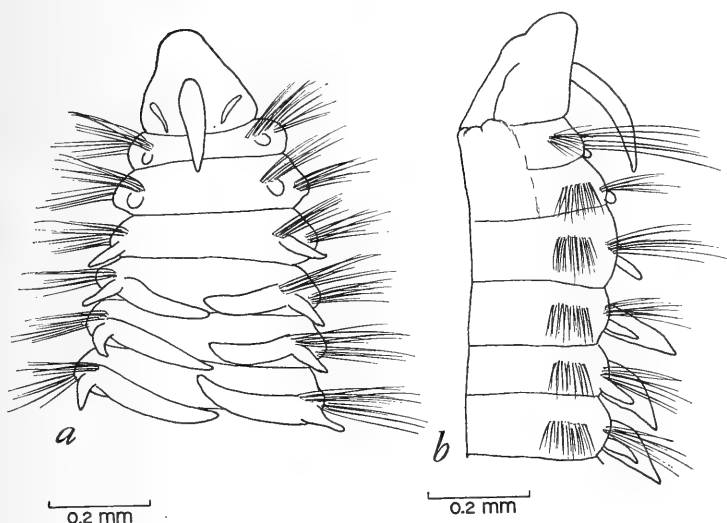


FIG. 6. *Aricidea jeffreysii*: a, Dorsal view anterior end; b, same, lateral view.

Hartmann-Schröder (1962: 135; Peru, 9 meters) and *A. capensis* Day (1961: 481; South Africa, 10 meters). The three species have branchiae beginning on setiger 4 and their posterior neuropodial hooks are bidentate. They differ in the following characters:

| | <i>A. brevicornis</i> | <i>A. capensis</i> | <i>A. taylori</i> |
|-----------------------------|---|--|--|
| Median prostomial antenna | Very short, globular, shorter than prostomium | Moderately long, tapering, extending to setiger 3, faintly annulate distally | Short, clubbed, extending to first setiger |
| Branchiae | 6 pairs | 14 pairs | 26–29 pairs |
| Posterior neuropodial hooks | Bidentate, without aristae | Bidentate, with aristae arising from concave sides | Bidentate, with aristae arising terminally between teeth |

The species is named for John L. Taylor, to whom I am indebted for the specimens.

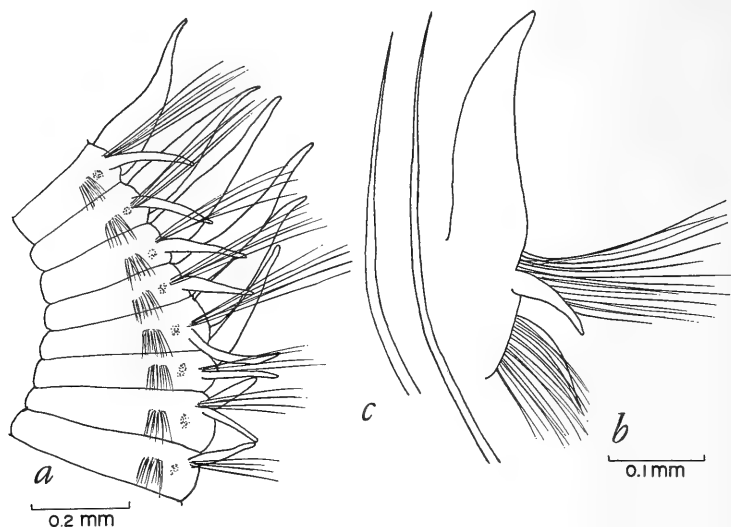


FIG. 7. *Aricidea jeffreysii*: a, Lateral view setigers 17-24 (branchial 14-20 and first postbranchial segment); last pair branchiae small; interramal brownish areas shown; b, parapodium from branchial region; c, notosetae from same.

Aricidea (Aricidea) jeffreysii (McIntosh)

Scolecolepis (?) *jeffreysii* McIntosh, 1879: 506, Pl. 65, Figs. 13, 14.

Aricidea jeffreysii Pettibone, 1963: 305, Fig. 80, a-e.—Day, 1963: 423.

Material examined: VIRGINIA, off Eastern shore in Chesapeake Bay, Marvin L. Wass, coll.: 37° 10' N., 74° 55' W., 24 fms., sand and shell, 25 August 1962 (3 spec.); 37° 34' N., 75° 55' W., 8 fms., mud and sand, 17 July 1963 (2 spec.); Hampton Bar, James River, 5 fms., silt, 13 November 1963 (1 spec.).

Description: Length to 20 mm, width to 1.5 mm, segments to 120. Body long, slender, subcylindrical, slightly flattened dorsoventrally in branchial region, tapering gradually posteriorly. Prostomium and achaetous buccal segment fused, subconical, widest posteriorly, rounded anteriorly; median antenna short, subulate, extending at most to setiger 2; pair of nuchal slits lateral to antenna. Lateral lips of mouth formed by achaetous buccal segment (fused to prostomium); ventral area of first two setigerous segments forming posterior lip of mouth. When extended, proboscis a short cylindrical ciliated sac.

Branchiae beginning on setiger 4, 11-22 pairs, nearly covering dorsum in branchial region. Notopodial postsetal lobes short, cylindrical on first

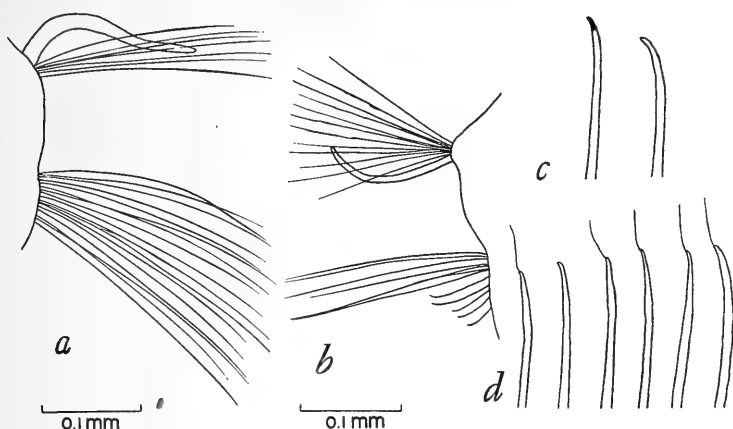


FIG. 8. *Aricidea jeffreysii*: a, Parapodium from anterior postbranchial region; b, same, from posterior postbranchial region; c, neurosetal hook from same; d, neurosetae with mucronate tips, from far posterior region.

two setigers, longer, subulate on setiger 3 and on branchial setigers, becoming filiform on postbranchial segments. Neuropodial postsetal lobes absent. Notopodia and neuropodia with thick bundles of setae in several rows in anterior prebranchial and branchial setigers; notosetae and neurosetae thickened basally, tapering to capillary tips; notopodia of postbranchial setigers with small bundles of slender, capillary notosetae; anterior postbranchial neuropodia with spreading bundles of long capillary neurosetae; more posteriorly, ventral capillary neurosetae replaced by unidentate hooks (4–8 in number; sometimes with faint hood or sheath; Fig. 8, c); in far posterior region, some of lower hooks with mucronate tips (Fig. 8, d). Pygidium subconical, with pair of lateral anal cirri. Color (preserved): variable, usually with rusty red or brownish pigment scattered on prostomium and on body, sometimes concentrated in dorsolateral interramal spots (Fig. 7, a).

Distribution: Davis Strait to Chesapeake Bay (off Eastern shore, Virginia), Ireland, Denmark, Mediterranean, South Africa, western Canada (Gulf of Georgia). In 1 to 1,060 fms.

***Aricidea (Aricidea) wassi*, new species**

Material examined: VIRGINIA, off Eastern shore in Chesapeake Bay, Marvin L. Wass, coll.: 37° 34' N., 75° 55' W., 8 fms., mud and sand, July 1963 (type-locality, 10 spec.); 37° 18' N., 75° 55' W., 14 fms., sand, 23 January 1963 (3 spec.); 37° 10' N., 74° 55' W., 24 fms., sand

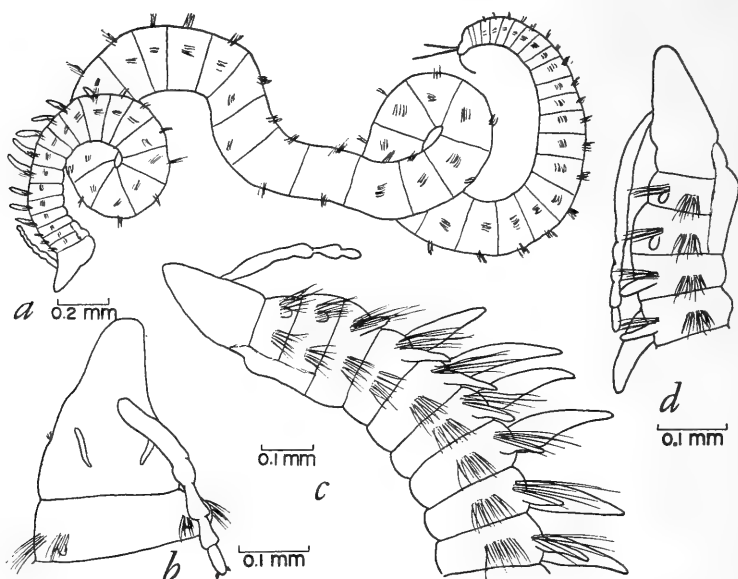


FIG. 9. *Aricidea wassi* new species: a, Lateral view of complete specimen of small paratype (about 65 setigers); b, dorsal view anterior end; c, lateral view anterior end; d, same, from another specimen with longer antenna.

and shells, 25 August 1962 (1 spec.). The types are deposited in the United States National Museum, holotype 31493, paratypes 31492.

Description: Length to 30 mm, width to 0.5 mm, segments to 200. Body elongate, slender, threadlike, widest anteriorly, gradually tapering posteriorly. Prostomium and achaetous buccal segment fused, elongate, subconical, widest posteriorly, rounded anteriorly; median antenna long, extending to setiger 3-5, distinctly jointed distally with 3-6 distal joints, indistinctly jointed basally; pair of nuchal slits posterior and lateral to antenna. Lateral lips of mouth formed by achaetous buccal segment (fused to prostomium); ventral area of first two setigerous segments forming posterior lip of mouth.

Branchiae beginning on setiger 4, 9 (small specimen) to 18 (larger specimen) pairs, wider basally, tapering distally. Notopodial postsetal lobes small, bulbous on first two setigers, longer, cylindrical on setiger 3, digitiform on branchial segments, becoming filiform posteriorly. Neuro-podial postsetal lobes absent. Notopodia and neuropodia with thick bundles of setae in several rows in anterior prebranchial and branchial setigers; notosetae and neurosetae thickened basally, tapering to capil-

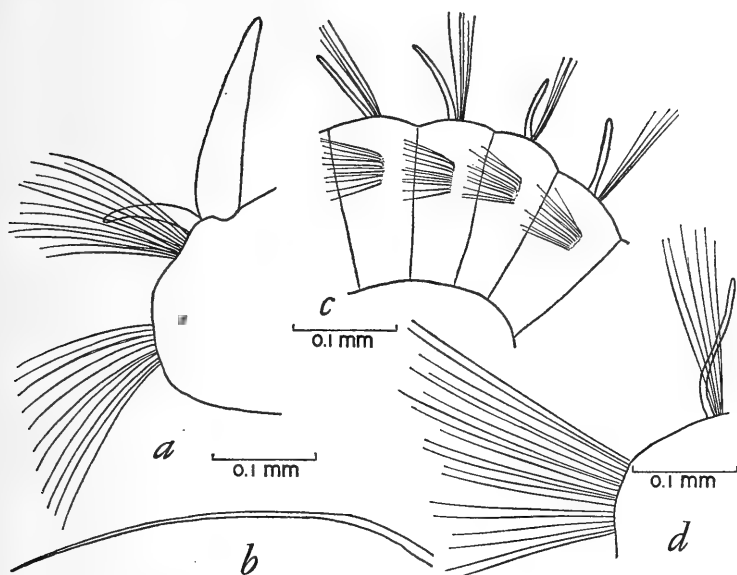


FIG. 10. *Aricidea wassi* new species: a, Parapodium from branchial region; b, lower neuroseta from same; c, lateral view few segments from anterior postbranchial region; d, parapodium from same.

lary tips; notopodia of postbranchial setigers with small bundles of notosetae composed of slender, capillary notosetae; anterior postbranchial neuropodia with spreading bundles of long capillary neurosetae; more posteriorly, lower capillary neurosetae replaced by unidentate hooks (5–6 in number) with long aristae emerging from their concave sides, hooks beginning about setiger 22 (small specimen) to setiger 40 (larger specimen). Pygidium bulbous ventrally, with three filiform anal cirri. Color (preserved): white or pinkish.

Distribution: Chesapeake Bay (off Eastern shore, Virginia), 8 to 24 fathoms, in mud and sand with shells.

Remarks: Of the species of *Aricidea* (*Aricidea*) which lack neuropodial postsetal lobes, *A. wassi* resembles most closely *A. minuta* Southward (1956: 269; Isle of Man, 34 fms.) and *A. longobranchiata* Day (1961: 482; South Africa, 3–48 fms.). In the three species, the branchiae begin on setiger 4 and the posterior neuropodial hooks are entire and with aristae arising from their concave sides. They differ in the following characters:

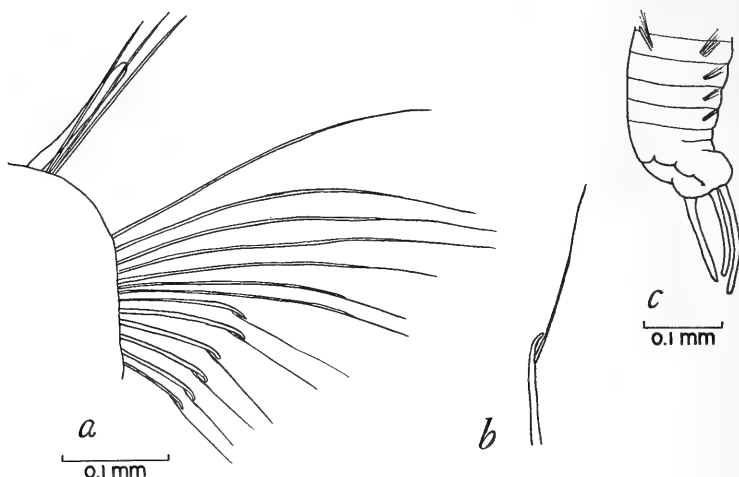


FIG. 11. *Aricidea wassi* new species: a, Parapodium from posterior postbranchial region; b, lower neuroseta from same; c, lateral view posterior end.

| | <i>A. minuta</i> | <i>A. longobranchiata</i> | <i>A. wassi</i> |
|---------------------------|--|---|--|
| Branchiae | 9-12 pairs, of uniform length | 18 pairs, last 2 or 3 pairs greatly elongated | 9-18 pairs, of uniform length, last pair shorter |
| Median prostomial antenna | Short, extending to first setiger, not jointed | Long, extending to setiger 5, smooth, not jointed | Long, extending to setiger 3-5, distinctly jointed |

The species is named for Marvin L. Wass, to whom I am indebted for these specimens, as well as many other interesting polychaetes from Chesapeake Bay.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

THE SMALLER TEIID LIZARDS (*GYMNOPHTHALMUS*
AND *BACHIA*) OF THE SOUTHEASTERN CARIBBEAN

BY RICHARD THOMAS

Miami, Florida

The recent herpetological and ornithological collecting led by Albert Schwartz in the Lesser Antilles has resulted in the acquisition of enough new material of the genera *Gymnophthalmus* and *Bachia* (formerly *Scolecosaurus*; see below) that an attempt can be made at clarifying their respective statuses in this region. I was fortunate in being able to participate in this collecting and in addition in being able to collect on Tobago and Trinidad in a brief search for pertinent comparative material.

I wish to express my appreciation to Dr. Schwartz for his support of this work and the use of his collections, here denoted as the Albert Schwartz Field Series (ASFS), and to the following persons for loan of specimens in their care: Mr. Charles M. Bogert, American Museum of Natural History (AMNH); Miss A. G. C. Grandison, British Museum (Natural History) (BM); Dr. William E. Duellman, University of Kansas (KU); Dr. Ernest E. Williams, Museum of Comparative Zoology, Harvard (MCZ); Dr. Charles F. Walker, Museum of Zoology, University of Michigan (UMMZ); Dr. Doris M. Cochran, United States National Museum (USNM); Père R. Pinchon, Séminaire College, Fort-de-France, Martinique (SC, specimens unnumbered); and Mr. Dennis R. Paulson (DRP). Specimens from my own private collection have been designated RT, and specimens from my collecting on Trinidad and Tobago by T. In addition, Mr. Paulson and Dr. Williams helped me greatly in obtaining necessary literature, for which they have my appreciation. I also wish to

thank Mr. Ronald F. Klinikowski for making the illustrations in this paper.

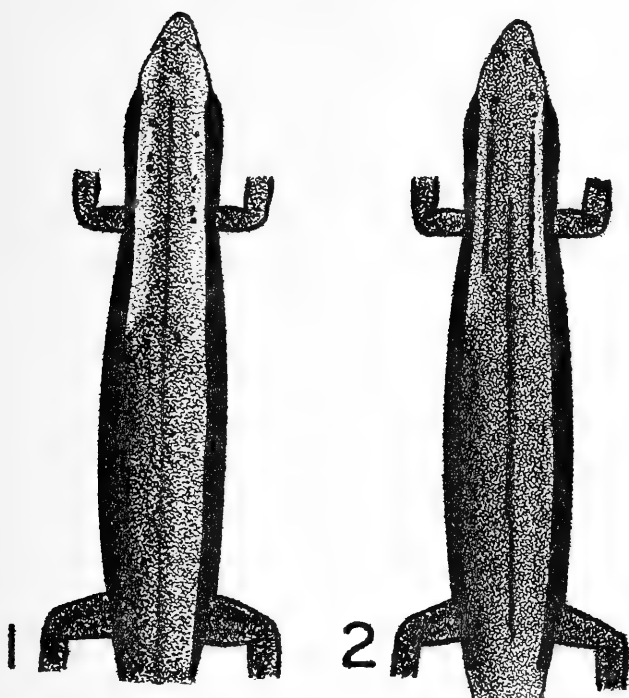
GYMNOPHTHALMUS

Gymnophthalmus pleei Bocourt is a rather distinct species inhabiting the islands of Martinique and St. Lucia. *Gymnophthalmus luetkeni* was described by Bocourt in the same paper with *pleei* (1881). It has recently been considered to be in the synonymy of *G. pleei*, but new material from both islands shows that the St. Lucia lizards are sub-specifically distinct and must therefore be known as *Gymnophthalmus pleei luetkeni*.

Some authors have assumed *Gymnophthalmus pleei* to be either extinct or quite rare on both islands due to depredations of the mongoose. On St. Lucia these lizards are abundant and widespread, though not easy to capture in many situations in which they occur; we obtained 25 during recent collecting. On Martinique they were found to be locally abundant on the Caravelle Peninsula, where more than 40 were captured. On the rest of Martinique they are apparently not so abundant as on St. Lucia and only one was seen by us at Ste.-Anne. A few have been collected in recent years from other scattered localities.

Of this bulk of Martinique specimens from the Caravelle Peninsula slightly more than 75 percent differ in number of midbody scale rows (19) from the eight available mainland specimens examined which all possess 17 scale rows. It may be, therefore, that enough fresh material from mainland Martinique would show the Caravelle lizards to be sub-specifically distinct on the basis of other characters such as coloration. The patterns of the Caravelle specimens agree favorably with other Martinique specimens, so it is felt that on this point the St. Lucia specimens may be safely contrasted with the Martinique material as a whole.

In *G. p. luetkeni* the dorsal ground color is metallic brown in life and is confined to a middorsal zone five scales in width on the trunk. A golden yellow canthal stripe proceeds caudad over each eye and onto the neck and body occupying the parts of two scale rows medial to the line of juncture of the middorsal zone with the lateral coloration. The yellow stripes widen slightly as they proceed posteriorly and generally fade out a short distance beyond the level of the insertion of the forearm, though they may continue faintly to mid-trunk or slightly beyond. A dark line borders each stripe medially. The sides are dark gray-brown and possess a narrow dark border at the juncture with the dorsal zone and dorsolateral light stripe. The venter varies from black to metallic greenish or bronzy. Many specimens have a scaly pattern to the venter caused by a concentration of dark pigment at the basal region of each scale. Variation in intensity of ventral pigmentation is caused by variation in the extent of this basal area of each scale. The ground color of the tail may be strikingly lighter than that of the body

FIG. 1. *Gymnophthalmus p. pleei* (MCZ 69445).FIG. 2. *Gymnophthalmus p. luetkeni* (ASFS X6645).

(possibly due to incomplete shedding) or of the same shade; the pattern consists of numerous, small, transverse, wing-like markings (one to each verticil) which are light laterally and dark centrally. There is a yellow post-auricular stripe which extends along the lower sides of the neck usually to just above the insertion of the forearm. The lower sides of the trunk may be invaded by light due to the presence of light-edged scales similar to those of the venter. In some specimens the post-auricular stripe sends a branch onto the forearm, beyond the forearm (or both) and onto the lower flanks, but it is generally lost in the striae which may be formed by the light-edged lateral scales.

Dorsal scales from nape to base of tail vary from 30 to 34 in 22 specimens; ventral scales from pectoral plates to anal scales vary from 23 to 28 in 21 specimens. Of 34 specimens, 32 have 17 scale rows at midbody, one has 19 and one 16. Parker (1933) recorded a specimen from St. Lucia having a midbody scale count of 15.

In coloration a comparison of St. Lucia specimens can only be made

with Martinique specimens from the Caravelle Peninsula, as there are no color notes from life for non-Caravelle specimens, and most of them are old, faded and badly preserved. The middorsal zone of the Caravelle specimens is brown, becoming darker medially, a condition not nearly so pronounced in St. Lucia specimens. The sides are dark brown; the hind limb is reddish brown and in obvious contrast to the body color, which is not the case with *luetkeni*. The ventral coloration of Caravelle specimens varies from gray to bronzy. Overall, *G. p. luetkeni* is a darker colored lizard; the post-auricular neck stripe is generally distinct and in contrast with the darker ground color, whereas in *pleei* the lower neck area is apt to be much invaded by light ventral coloration. The same difference applies to the lower sides, those of *pleei* being in general lighter. The chin and gular region is also lighter and more often completely unmarked in *pleei*.

With respect to pattern the most salient and constant difference between *pleei* and *luetkeni* is the dark medial border to the light dorso-lateral stripes. In the former these are, in the majority of specimens, irregular or discontinuous and are frequently separated from the stripe itself by a strip of ground color (Fig. 1). In the latter the light stripe is typically narrower and is followed closely by a continuous, dark medial border (Fig. 2).

As previously mentioned, better than 75 percent of Caravelle *pleei* are 19-row lizards while the remaining percentage plus the specimens from Martinique proper are 17-row lizards, as is also the case with *luetkeni*. One specimen (MCZ 6044) from Fort-de-France possesses 15 (or 16) rows at midbody. Of two specimens (MCZ 69445, 69446) from Ilet Chancel, just to the south of the Caravelle, one has 19 and one 17 scale rows. Ventral scales (29–35 in 42 specimens) and dorsal scales (24–31 in 41 specimens) are not significantly different from those of *luetkeni*. Femoral pores are 7/7 (5), 8/7 (2), 8/8 (2), or 6/7 (1); St. Lucia specimens were 7/7 or 8/8.

A single specimen of *Gymnophthalmus* was collected on the southernmost of the Maria Islands which lie a short distance to the east of the southern end of St. Lucia. This specimen differs sufficiently from other *G. pleei* to warrant recognition of a separate subspecies.

***Gymnophthalmus pleei nesydrion*, new subspecies**

Diagnosis: A subspecies of *Gymnophthalmus pleei* characterized by reduced body keeling and chromatic differences.

Holotype: MCZ 77151, an adult female collected on the southernmost of the two Maria Islands, Vieux Fort Quarter, St. Lucia, 6 April 1963 by Richard Thomas.

Range: Known positively only from the type-locality but possibly occurring on the adjacent mainland of St. Lucia.

Description of holotype: Snout-vent length 41 mm. Four supralabials to posterior border of eye. Thirty-two middorsal scales from nape (first

scale behind parietal) to base of tail; 27 ventrals from pectoral plates to anal shield; 17 scale rows around midbody. Lateral and dorsal portion of tail strongly keeled with keels becoming fainter ventrally and disappearing on large midventral row. Keeling extending faintly onto five most dorsal rows of posterior trunk scales but fading out very quickly, faint keels being evident for about six scales anterior to the groin on either side and for a few more on the middorsal row. Coloration: The pattern is generally similar to that of *luetkeni*. The dorso-lateral light stripe, though faint on the canthus, extends prominently from the last supraocular along the neck and fades posterior to the level of the forearms; it is bordered medially by a dark line which follows it closely. The post-auricular stripe is prominent and extends to the insertion of the forearm and onto the anterodorsal portion of the extended arm. A faint flank stripe is evident in the preserved specimen. The venter has the scaly appearance due to concentration of dark pigment at the center of scales. Color notes from life state: "Dorsal ground color rich copper, hindlimb reddish, not prominently contrasting; sides reddish brown, not dark brown or black; upper line golden, outlined medially by dark brown, lower line golden, extending far back on sides; ventral ground color opalescent, chin a bit paler."

Comparisons: Examination of 78 specimens of *G. pleei* from Martinique and St. Lucia failed, with the exception of five specimens, to turn up any with the body keeling so reduced as in the type of *nesydron*. The five exceptions are from a series of six collected by G. R. Proctor at Vieux Fort, St. Lucia, which is the portion of the main island adjacent to the Maria Islands. The possibility therefore exists that *nesydron* occurs on the adjacent mainland or that its influence is felt there. The presence of a rather well-keeled specimen in this series leads to the latter assumption, that the Vieux Fort region supports intermediate examples. Unfortunately, due to preservation and fading, the specimens no longer bear their true colors and cannot be compared in this respect. *G. p. nesydron* differs from *pleei* in pattern much the same as does *luetkeni*. In coloration its rich copper colored dorsum differs from either of the browns of *pleei* and *luetkeni*; likewise its reddish brown sides differ from the dark brown or gray-brown of the other two races.

It is tempting to hypothesize a close relationship between *Gymnophthalmus pleei* and *Gymnophthalmus lineatus* from Curaçao. The following points may be noted in support:

1. The pattern of Curaçao *lineatus* is merely an intensification of the *pleei* pattern, having all of the main pattern elements mentioned for *pleei*.
2. The keeling of the tail in Curaçao *lineatus* is greater than in *speciosus*; it commonly occupies the distal $\frac{3}{4}$ of the tail and is therefore a stage less developed than that of *pleei* in that it does not extend onto the body.

3. The preantibrachials, large in *speciosus* and apparently in mainland *lineatus*, are small in Curaçao *lineatus* and smaller yet in *pleei*.

4. Curaçao *lineatus* (and mainland *lineatus*) is closer to *pleei* in having 15 scale rows around midbody than in *speciosus* which typically has 13.

The precise status of mainland *lineatus* is difficult to determine at this point. Of two specimens which I have seen which were previously identified as *lineatus*, one (MCZ 22157 from Valencia, Venezuela) does indeed have a faint, narrow lower flank line; it also has 15 scale rows at midbody; however, it has enlarged preantibrachials as does *speciosus*. Another specimen (MCZ 25985 from Colombia) also identified as *lineatus* shows, probably due to its rather advanced stage of preservation, only a very slight suggestion of a lower flank stripe. It does, however, also have enlarged preantibrachials and 15 scale rows. This latter specimen agrees in a peculiarity of its color pattern (immaculate venter with dorsal coloration ending abruptly along a ventrolateral line) with a presumed *speciosus* (MCZ 16838 also from Colombia) which too has 15 scale rows and enlarged preantibrachials. The degree of tail keeling is also advanced on these two specimens. It has been suggested that the mainland *lineatus* might be a mere color variant or a race of *speciosus* (Parker 1935, *fide* Stuart 1939). This does not seem entirely likely, but the evidence is too slim at present for a decision. Whatever the eventual allocation of mainland *lineatus*, it is hard to by-pass the similarities between *pleei* and the Curaçao lizard. (Of interest is the fact that when Duméril and Bibron gave their summary of *G. lineatus* they gave its range as Brazil and Martinique and apparently based their description, at least in part, on a Martinique specimen, as they describe a specimen with five rows of keeled dorsal scales.)

Grant described *Gymnophthalmus underwoodi* from Barbados in 1958, and Underwood (1962) noted its existence on Trinidad. In the description of *underwoodi* Grant commented on the lack of femoral pores in the 14 specimens of the type-series and wondered if they might not all be females. Examination of over 40 additional specimens from Barbados plus 21 from Trinidad reveals a lack of femoral pores in any of the specimens. Further, examination of all but the smallest juveniles for gonads reveals that all of these specimens are indeed females. Barring a rather bizarre sex ratio or peculiarly cryptic habits on the part of the males it seems likely that *Gymnophthalmus underwoodi* can be added to the list of lizards (mostly teiids) having unisexual populations. Another fact in support of this is the low amount of variation in scale characters in these two populations as compared with other populations of *Gymnophthalmus*, cf. *pleei* and *luetkeni* (see tables).

Through a lapsus *G. underwoodi* is diagnosed as having from five to nine more belly scales than *speciosus* rather than fewer belly scales which is evident from the data presented. The large additional series from both Barbados and Trinidad roughly bear out this difference when

TABLE 1. Dorsal scales from parietal to base of tail in *Gymnophthalmus*.

| | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|
| <i>pleei</i> | 1 | 3 | 12 | 9 | 10 | 3 | 1 | — | — | — | — | — |
| <i>luetkeni</i> | — | 2 | 5 | 4 | 9 | 2 | — | — | — | — | — | — |
| <i>lineatus</i> | | | | | | | | | | | | |
| (Curaçao) | — | — | — | — | — | 1 | 2 | 6 | 1 | — | — | — |
| <i>underwoodi</i> | | | | | | | | | | | | |
| (Barbados) | — | — | 2 | 9 | 18 | 4 | — | — | — | — | — | — |
| <i>underwoodi</i> | | | | | | | | | | | | |
| (Trinidad) | — | — | 3 | 10 | 4 | 1 | — | — | — | — | — | — |
| " <i>speciosus</i> " | | | | | | | | | | | | |
| (S. A.) | — | — | — | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | — |
| " <i>speciosus</i> " | | | | | | | | | | | | |
| (C. A.) | — | — | — | — | 1 | 6 | 4 | 4 | 2 | 3 | 2 | 1 |

TABLE 2. Ventral scales from pectoral plates to anal shield in *Gymnophthalmus*.

| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|------------------------------|----|----|----|----|----|----|----|----|----|----|----|
| <i>pleei</i> | — | — | — | 3 | 11 | 3 | 13 | 7 | 1 | 0 | 1 |
| <i>luetkeni</i> | — | — | 1 | 1 | 7 | 8 | 1 | — | — | — | — |
| <i>lineatus</i> (Curaçao) | — | 1 | 0 | 1 | 0 | 5 | 2 | 0 | 1 | — | — |
| <i>underwoodi</i> | | | | | | | | | | | |
| (Barbados) | 5 | 17 | 11 | — | — | — | — | — | — | — | — |
| <i>underwoodi</i> (Trinidad) | 2 | 8 | 6 | 1 | — | — | — | — | — | — | — |
| " <i>speciosus</i> " (S. A.) | — | — | 2 | 2 | 1 | 0 | 2 | — | — | — | — |
| " <i>speciosus</i> " (C. A.) | — | 2 | 2 | 3 | 1 | 4 | 3 | 2 | 3 | 1 | — |

compared to Central American "*speciosus*" (*sensu lato*. For the sake of convenience in comparing Central and South American *Gymnophthalmi* with *underwoodi* I have lumped specimens of supposed *sumichrasti* and *birdi* with *speciosus*; no nomenclatorial change is intended, as this is not within the province of this paper) although there is some overlap (see tables). When the small and obviously heterogenous sample of "*speciosus*" from South America is compared with *underwoodi* it is seen that the specimens from Venezuela and British Guiana are closer than are those from Colombia (and one from Chile). Comparisons of the dorsal scale counts (parietal to base of tail) of *underwoodi* and "*speciosus*" shows much the same pattern with a greater difference with respect to Central American "*speciosus*" than observed for the ventral counts. The series of "*speciosus*" from South America includes one specimen from Georgetown, British Guiana (MCZ 61030, collected

by Underwood and identified as *underwoodi*) which is possibly the basis for Underwood's (1962) surmise that the species may occur in British Guiana. This specimen and another similar one (USNM 145454) from the vicinity of Georgetown are darkened from preservation and have lost their original coloration, though they do bear a certain resemblance to similarly preserved *underwoodi*; their scale counts do not preclude the possibility of their being closely related or identical. For another specimen from Los Frailes Islands off Venezuela (MCZ 50146) and for USNM 72755 from San Juan de los Morros, Aragua, Venezuela (a male) practically the same can be said as for the last two, except that the state of preservation is worse. However, a specimen from San Tomé, Anzoáteguí Province, Venezuela, is not identical to *underwoodi* due to coloration differences (light tail and bolder pattern). This specimen is from a locality farther to the east (and therefore nearer to Trinidad) than is the rather indeterminate specimen from San Juan de los Morros.

From the foregoing it can be seen that *underwoodi* differs little if at all in morphological characters from some *Gymnophthalmus* of the adjacent mainland. However, we must await comparable series of fresh specimens from the mainland to determine its precise relationships. The presumed unisexuality of both island populations of *underwoodi* and the resultant lack of interbreeding potential with mainland lizards also argue for the retention of species status.

BACHIA

Vanzolini (1961b) discussed the supposed distinctions between *Scolecosaur* and *Bachia*; he concluded that these were not consistent and that *Scolecosaur* must therefore be considered a synonym of *Bachia*. Though I do not have a wide acquaintance with the various species of *Bachia* (old sense), it appears that Vanzolini is correct, and I follow his usage. A new species of *Bachia* from Brazil (Thomas, 1965) further confirms the lack of distinction between the genera.

The species and subspecies of *Bachia* which were formerly recognized in the genus *Scolecosaur* are listed as follows:

- Bachia cuvieri* Fitzinger
- Bachia pallidiceps* Cope
- Bachia alleni alleni* Barbour
- Bachia alleni parviceps* Barbour
- Bachia trinitatis* Barbour

Barbour (1933) discussed the nomenclatorial history of *Bachia cuvieri*; from this discussion the following points may be noted:

1. The type-specimen of *cuvieri*, formerly in the Vienna Museum, is lost.
2. The type was of unknown provenance.
3. The first detailed description of *cuvieri* was given by Duméril and

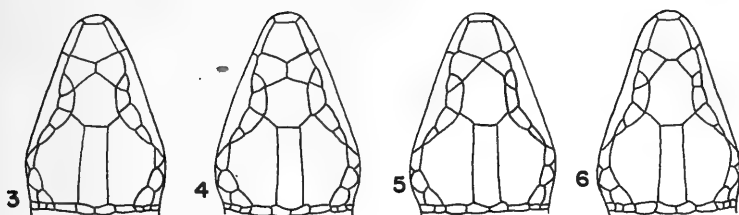


FIG. 3. *Bachia alleni alleni* (ASFS X7145 from Grenada) showing median prefrontal contact.

FIG. 4. *Bachia alleni alleni* (T152 from Tobago) showing median prefrontal contact.

FIG. 5. *Bachia alleni alleni*, provisional (specimen collected by Père R. Pinchon on Bequia Island), showing apical contact of prefrontals, a condition occurring in some *B. trinitatis*.

FIG. 6. *Bachia alleni trinitatis* (T114 from Trinidad) showing broad separation of prefrontals and consequent frontal-internasal contact.

Bibron (1839: 453), and this was a composite based on three specimens from the Paris Museum. No detailed description was given at the time of the naming of the species.

4. Barbour regarded *cuvieri* to be characterized by having the prefrontals in contact medially along a short suture (Figs. 3 and 4). He did not in any adequate way re-diagnose *alleni*, which was originally distinguished from *cuvieri* on the basis of Duméril and Bibron's description.

The two specimens in the British Museum and the Paris Museum which Barbour considered to be *cuvieri* have no adequate locality data other than "Brazil" or "West Indies."

The following conclusions are drawn from the foregoing:

1. There is no basis for associating the name *cuvieri* with any particular one of the four-toed *Bachia*.

2. If we follow Barbour in regarding *cuvieri* as a species with the prefrontals in contact and otherwise having characteristics common to those species formerly considered to be in the genus *Scolecosaururus* (i.e. quadrangular, non-imbricate ventral scales), then the name could possibly apply to:

a. *B. alleni* from Grenada

b. An unverified species from South America possessing these characteristics.

In the former case the conclusion of Burt and Burt (1931) that *alleni* is a synonym of *cuvieri* would be correct. As there is no present basis for deciding between these alternatives, I choose to retain the name *alleni* for the Grenada population and to hold the name *cuvieri*

in abeyance until sufficient evidence is obtained to 1) either apply it to a population of lizards or 2) to recommend its rejection. If the type is indeed lost the latter course of action seems best. *Cuvieri* is not applied to any specimens in collections unless they possess the characteristics mentioned above and are definitely from South America (a situation which apparently does not exist). I have examined two specimens of supposed *cuvieri* from the British Museum (B. M. 53.2.4.63 and R. R. 1961.1861); these are both from "South America" and were obtained in the 1860's. Neither are distinguishable from *alleni*.

Should it be noted that in Barbour's (1914) description of *alleni* that there are mentioned some rather significant differences between *alleni* and the specimens Duméril and Bibron possessed, attention is brought to the fact that Barbour mistranslated in two instances. *B. alleni* was contrasted with the Duméril and Bibron description as having the fifth upper labial (of six) pentagonal in shape in contrast to seven upper labials of which the fifth is a scalene triangle. In actuality Duméril and Bibron stated that it is the third upper labial which resembles a scalene triangle; the fifth they considered to resemble roughly an isosceles triangle, which is true for *alleni*, though as more precisely stated by Barbour it is pentagonal. Moreover, Duméril and Bibron (1839: 455) stated that *cuvieri* has only five upper labials of which the last two are the smallest. This statement is probably an error, as none of the specimens examined by me have either as few as five upper labials, or have the last two the smallest.

Thirty-five specimens of *Bachia* from Grenada were examined, 36 from Trinidad, six from Tobago and three from the Grenadines. In counts of scales around midbody, dorsal scales from nape to hindlimb and ventral scales from pectorals to anal shield the ranges are almost identical for the three larger series, and the specimens from the Grenadines are within the range of the others. *B. alleni* and *trinitatis* were originally differentiated on the basis of broad prefrontal contact for the former (Figs. 3 and 4) and separated prefrontals for the latter (Fig. 6). Roux (1926) noted that two of 16 specimens from Trinidad had the prefrontals joined in a median suture. This condition occurs also in the present large series: five have prefrontal contact in a median suture and one has but apical contact of the prefrontals (Fig. 5). Nonetheless, it was observed that even in those specimens with the prefrontals joined medially, the contact was not so great as with the Grenada specimens. A result of the varying contact of the prefrontals is that the frontal is longer in those specimens with less contact (to the extreme of complete prefrontal separation in which the frontal is in contact with the internasal) and shorter in those specimens with greater contact. When this is expressed as a ratio of length of prefrontal suture/frontal length, it is found that these series of Grenada and Trinidad *Bachia* are completely separable on this basis. (The measurements were taken with an optical micrometer at 20 \times magnification.) The longer prefrontal suture and consequent shorter frontal of the Grenada material

yields a range of values from .09 to .24; the lack of prefrontal contact or apical contact (suture length value of zero) or short prefrontal contact and consequently longer frontals of the Trinidad material yielded values from 0 to .08. Interestingly, the Tobago *Bachia* are definitely closer to those from Grenada, yielding a range of values for this ratio of .17 to .25.

Another character that demonstrates some degree of divergence between the Trinidad and Grenada populations is the width of the band of imbricate scales across the back. The Grenada specimens have an imbricate band width at midbody that varies from seven to nine scales with 82 percent of the specimens having band widths of seven or eight. The Trinidad specimens have imbricate band widths of nine to 11 with 66 percent having widths of 10 to 11. Again the six Tobago specimens show affinity with the Grenada material, having imbricate band widths of seven and eight.

Vanzolini (1961a) gave a redescription of *Bachia trinitatis* based on a single paratype in the collection of the Departamento de Zoologia at São Paulo. In this paper and in the other (1961b) he regarded *trinitatis* as being the only one of those species formerly in the genus *Scolecocaurus* possessing the prefrontals not in contact and further regarded it (1961a) as being at the extreme range of variation for the genus (*Scolecocaurus*). This is strange, as one of the most salient characteristics of the specimens of *pallidiceps* (from Colombia and the Darién) examined by me is the widely separated prefrontals (more so than in *trinitatis*). This fact can be considered to support Vanzolini's (1961b) contention that *Scolecocaurus* is synonymous with *Bachia*, as it further breaks down the distinction of presence or absence of prefrontal contact.

Barbour (1933) and Brongersma (1946) mentioned the occurrence of *Bachia trinitatis* on the mainland, more specifically from the lower Orinoco and the banks of the Orinoco. Another specimen (MCZ 43880) from the Paria Peninsula of Venezuela is also assignable to *B. trinitatis*; in scale counts it and the counts for the specimen examined by Brongersma (1946) are within the range of *trinitatis*. As a further refinement of the ratio used above to differentiate *alleni* and *trinitatis*, the length of separation of the prefrontals (*i.e.* the length of the frontal-internasal suture) over the length of the frontal may be given a negative value, thus indicating the degree of separation of the prefrontals. A continuous scale from broadly connected prefrontals to widely separated prefrontals can thereby be set up. When this latter ratio is applied to the Paria Peninsula specimen a value of $-.20$ is obtained which is just below the lowest value obtained for the Trinidad specimens ($-.19$). This lends support to the possibility that Trinidad may prove to be an area of intermediacy between a mainland race with widely separated prefrontals and *alleni* with broadly connecting prefrontals.

All three specimens from the Grenadines have imbricate band widths of seven scales at midbody, which definitely allies them with Grenada. The type of *parviceps* (MCZ 32345) has a prefrontal suture/frontal

length ratio of .14 which places it within the range of the Grenada material with which it is best considered synonymous. The two specimens from Bequia (AMNH 90516 and a specimen collected by Père R. Pinchon of Martinique) both have apical contact of the prefrontals (Fig. 5), a condition which was not found in Grenada specimens. The Bequia *Bachia* may well represent a distinct form from that island but considering variation of the characters in question in the larger series of *Bachia* from other localities, it is best to wait until more material comes to light.

The following West Indian forms of *Bachia* are recognized:

Bachia alleni alleni: Grenadines (Cannouan, Bequia), Grenada, Tobago.

Bachia alleni trinitatis: Trinidad and the adjacent South American mainland.

SPECIMENS EXAMINED

Gymnophthalmus pleei pleei: MARTINIQUE: Fort-de-France, MCZ 6044, SC (three specimens); St.-Pierre, MCZ 6045; Case-Pilote MCZ 69445; Ilet Chancel off Robert, MCZ 69446-47; Ste.-Anne, USNM 123837; Tivoli, USNM 121251; 3 km NE Tartane, Château Dubuc, ASFS 18762-66, X387-419, DRP 250-251, RT 344-48.

Gymnophthalmus pleei luetkeni: ST. LUCIA: UMMZ 55878, 61134. Castries Quarter: Castries, MCZ 6042-43, 58751-52, AMNH 38969; Vigie Beach, ASFS X6645-54, RT 362. Dauphin Quarter: Petite Anse River, ASFS X6675-76, X6742-47, DRP 2662. Anse la Raye Quarter: 0.6 mi. E Anse la Raye, ASFS X6670; Anse Galet, ASFS X6671; Anse Galet Estate, ASFS X6766; Venus Estate, ASFS X6771. Praslin Quarter: Praslin Estate, 300', MCZ 69448-49. Vieux Fort Quarter: Vieux Fort, MCZ 58752-56.

Gymnophthalmus pleei nesydrion: ST. LUCIA: Vieux Fort Quarter: Maria Islands, southernmost of two, MCZ 77151.

Gymnophthalmus underwoodi: BARBADOS: USNM 30991-92. St. Michael Parish: Bridgetown (Queen's College), ASFS X6845. Christ Church Parish: Coverly, ASFS X6777-805, DRP 2663-64, RT 388-89. St. Peter Parish: Heywoods Beach, ASFS 6815-24. St. Lucy-St. Peter Parishes: Gay's Cove, MCZ 75021. TRINIDAD: St. George Co.: Tacarigua Ward: Imperial College of Tropical Agriculture, AMNH 72849; St. Augustine, MCZ 66942-52; St. Ann's Ward: Port-of-Spain, MCZ 61031-32; Santa Cruz Valley, 7.5 mi. N San Juan, T50-54. St. David Co.: Toco Ward, 2 mi. SE Toco, T219. (Probably Trinidad) St. Andrew Co.: Manzanilla Ward, Manzanilla Beach, MCZ 60982.

Gymnophthalmus lineatus: CURAÇAO: USNM 64170-71, 90906; Chincho, MCZ 69599-601; Tafelberg of St. Hyronimus UMMZ 57165, 57168; 1 km from Landhuis toward St. Christoffelberg UMMZ 57166-67; Landhuis Knip, UMMZ 57170; St. Christoffelberg, 1200', UMMZ 57171.

Gymnophthalmus "speciosus": BRITISH GUIANA: Georgetown,

MCZ 61030; 50 mi. above Georgetown up Abary River, USNM 145454. VENEZUELA: Islas Los Frailes, MCZ 50146; Anzoátegui Province, San Tomé, USNM 140249; Guarico Province, San Juan de los Morros, USNM 72755; Aragua Province, Valencia, MCZ 61030. COLOMBIA: Río Frío, MCZ 25985; Antioquia Province, Antioquia, AMNH 32770; Magdalena Province, Santa Marta Mts., Bolívar, MCZ 16838. CHILE: Coquimbo Province, El Tofo, AMNH 38816. PANAMA: Canal Zone: AMNH 83578; Ft. Randolph nr. Colón, MCZ 18913-14; Bruja Point, nr. Pacific end, MCZ 24393-95; Ancón, MCZ 32529; Rosseau, KU 61793-94; Camp Chagres, 120 m, KU 76173. Cocle, El Valle de Antón, AMNH 88314; Panamá Viejo, 5 m, KU 76171; South Slope Cerro de la Campana 740 m, KU 76172. COSTA RICA: Buenos Aires de Feirata, MCZ 38688. HONDURAS: Yequaré River Valley, 17 mi. SW of Tegucigalpa, MCZ 48688; Tegucigalpa, MCZ 49776-80, 49997; F. Morazan, EAP, El Zamorano, AMNH 85477. NICARAGUA: Polván, MCZ 5783 (3). MEXICO: Oaxaca: 20 mi. from Tehuantepec, MCZ 46462; Tehuantepec, Salazar, AMNH 66949; Tehuantepec, Quiengola, AMNH 66950.

Bachia alleni alleni: GRENADA: St. George Parish: St. George's, MCZ 7793 (3) (types), USNM 43218-9, AMNH 38968; Annandale Estate, USNM 79190; 0.20 mi. E Willis, 550', ASFS X6852-53. St. Andrew Parish: Grand Etang, MCZ 9005-09. St. David Parish: 1 mi. SE Vincennes, 600', ASFS 6847-48; Bailey Bacolet Stock Farm, ASFS X7144-55, X7360, DRP 2667-68; north shore of Westerhall Bay, ASFS X7158; 1 mi. N Vincennes, 1400', ASFS X7175. St. Patrick Parish: 0.8 mi. S Sauteurs, ASFS X7196-99; Mt. Alexander, ASFS X6998. GRENADINES: Cannouan Island, MCZ 32345; Bequia Island, AMNH 90516, SC (one specimen). TOBAGO: 4 mi. NE Pembroke, T149-53; 4 mi. N of Mount St. George, T169.

Bachia alleni trinitatis: TRINIDAD: AMNH 1608, 38815. St. George Co.: St. Ann's Ward: Santa Cruz Valley, 7.5 mi. N San Juan, T49, T110-19; Port-of-Spain, UMMZ 55768; Tacarigua Ward: Caura Valley, MCZ 39689; Mt. Tucuche, MCZ 32521; Morne Bleu, AMNH 72852; Arima Ward, Arima Valley, AMNH 81486; Blanchisseuse Ward, Blanchisseuse, MCZ 55675; Diego Martin Ward, AMNH 64458 (3), 64522 (4). Caroni Co.: Montserrat Ward: Caparo, MCZ 8947 (type), 8950-52 (paratypes), USNM 120795. Victoria Co.: Pointe-a-Pierre Ward, Pointe-a-Pierre, MCZ 49062-63; Princetown-Moruga Road, USNM 107651. St. Andrew Co.: Manzanilla Bay, USNM 141583. Venezuela: Monagas Province, Paria Peninsula, MCZ 43880.

Bachia pallidiceps: COLOMBIA: Chocó, Atrato Region, Quesada River, AMNH 18230. PANAMÁ: Yaviza, Darién, MCZ 37750.

ADDENDUM

To the localities for *Gymnophthalmus underwoodi* may be added the Lesser Antillean island of St. Vincent. I have examined MCZ 79729-34 referable to this form, recently collected at Cane Garden, south of Kings-

town, St. Vincent, by Mr. James D. Lazell, Jr. The specimens do not seem to differ from others of the species I have seen.

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PROCEEDINGS
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A NOTE ON *LOLIGO COROLLIFLORA* TILESIIUS,
1829, A LONG FORGOTTEN SQUID
FROM EASTERN SEAS¹

BY GILBERT L. VOSS

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My colleague, Frederick M. Bayer, the well-known octo-
corallian authority, has kindly drawn to my attention an old
and obscure paper by W. G. Tilesius. It is entitled "Beiträge zur
Naturgeschichte der Medusen. I. Cassiopeae" and was pub-
lished in June 1829 in *Nova Acta Academiae Caesareae Leo-
poldino-Carolinae Germanicae naturae Curiosorum*. On pages
286 and 287 of this work is the description of a new species
of squid from China, *Loligo corolliflora*, accompanied by ex-
cellent color illustrations (Plate LXXIII) of the whole animal,
a view of the mouthfield and ventral and lateral views of the
gladius. These are included on a plate illustrating the habit
and anatomy of *Cassiopea canariensis*.

That omnivorous bibliophile and researcher, Sherborn,
listed *L. corolliflora* in his *Index animalium* but apparently
the name has evaded the eyes of teuthologists since its pub-
lication. D'Orbigny does not mention it in his great *Histoire
Naturelle*, nor does Tryon include it in the first volume of the
Manual of Conchology. A survey of cephalopod literature
failed to turn up even a passing reference. While there is no
question that *L. corolliflora* is validly described, it is ques-
tionable whether the species could be recognized today from
the somewhat inadequate description and *au nature* illustra-
tions. The whereabouts of the type is not mentioned but it
is presumed to be preserved in one of the old German or

¹ Contribution No. 000 from The Marine Laboratory, Institute of Marine Science,
University of Miami.

Russian museums. The entire question is, however, rather moot since even if its identity could be determined and priority established, it is beyond question a *nomen oblitum* and no service would be rendered to teuthology by reintroducing it.

Since the manner in which *L. corolliflora* is described is rather curious I give below a translation (mine) from the German of the description of *Cassiopea canariensis* containing it with the expectation that others will find it of interest. The original pagination is indicated and original German equivalents are placed in parentheses.

(Page 285) "In the same way that *Cassiopea frondosa* Palasii (Plate LXXII Figure 5) appears as it were double stalked owing to the 8 central branchlets of their 8 large bushy arms at the middle point of the stalk, so also *Cassiopea rhizostomoidea anglica* is distinguished by a similar small stalk in the middle point of the larger, because 4 shield shaped and 4 heart shaped leaves ("Cotyledonen") in the middle of the larger stalk are united to a smaller one; (page 286) thus the present species also shows a similar structure of 8 small arms in the middle—or points of union of the 8 large arms, and forms a second small stalk (Pl. LXXIII, Fig. 2, *pp*) in the middle of the larger one. It is further found that this double construction equally occurs in more species of the family and to some extent appears to take part in the structure of the family characters. A noteworthy parallel occurs in the 8 small arms of a Chinese squid (*Loligo corolliflora*, Pl. LXXIII, Fig. 5. *aaaa*) which are surrounded by the 8 large arms of this animal as also in *Loligo pealii* of Mr. Lesueur in which a similar construction of the double arms is found which I have already shown above in the statement of the family characters of this medusoid tribe. I have included *Loligo corolliflora* for comparison in figures 4, 5, 6 and 7 of Plate 73 in order to represent with this remarkable example a corresponding double construction. Figure 5 is truly characteristic since it presents the central mouth of the animal with its parrot beak (*c*), which is surrounded by the wrinkled circular lip and the 8 small pebbly arms *a a* and further toward the outside by the 8 large arms *b b* which are provided on the inner side with sucker tubercles by which they introduce prey to the beaks and can hold them fast, thus the squid, like all other cuttlefishes and octopods are radially surrounded; it is the chief plan in the evaluation of these animals and one must maintain it because of the well developed 8 arms which surround the central mouth the same as rays. The fourth figure represents the animal viewed laterally, *b* are the arms, *p* the (page 287) 2 catchers ("Fänger") with the sucker tubercles on their club shaped ends which serve them as

anchors in storms and surf. The animal can retract within his mantle ("Scheide") the entire head with the eyes, from which projects in front under the neck a squirter ("Sprütze") or reversed funnel through which the animal squirts its ink when it defends itself. The outer sheath-like covering, provided ventrally with 2 heartshaped fins, is supported on the back by a horny, thin, transparent support shaped like a feather which can be easily extracted. This part is illustrated in Figure 6 in side view, in Figure 7 from in front or from the inner surface."

The above paper is of interest in several ways, not the least of which is the evidence of the strong influence of Goethe's archetype philosophy upon Tilesius. The search for unifying principles of design here resulted in a concept of the organization of *Loligo* clearly unacceptable on the basis of sound anatomical research. The orientation of the animal as given by Tilesius was one favored by most cephalopod workers until comparatively recently and is unrelated to the functional orientation. He was wrong, however, in believing that *Loligo* can withdraw the head completely within the mantle cavity. Only *Cranchia scabra*, to the writer's knowledge, can accomplish this feat, although in *Loligo* the head is capable of considerable anterior-posterior movement.

Other features of Tilesius' observations correspond to the familiar anthropomorphic thinking of the period. It is true that the "catchers" or tentacles are used in the squids for seizing their prey but there is no evidence to support his further theory that they are used "as anchors in storms and surf." Whether he was familiar with the function of the funnel as a swimming organ is not known but it is unlikely since he ascribes to it only the functions of squirting ink.

Tilesius later published several other works better known to teuthologists and containing much worthwhile information.

It is useless at this time, and without access to the type upon which Tilesius' figures and description are based, to attempt to relate *Loligo coralliflora* to any presently recognized species. Although the name is a *nomen oblitum* in the true sense of the word, it would be interesting to know the species described. It is hoped that some European workers, having access to Tilesius' collections, may be spurred to locating the specimen and clarifying the interesting puzzle presented here.

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TWO NEW GENERA AND SPECIES OF THE
OSTRACOD FAMILY ENTOCYTHERIDAE
WITH A KEY TO THE GENERA

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6921 Mansfield Road, Falls Church, Virginia

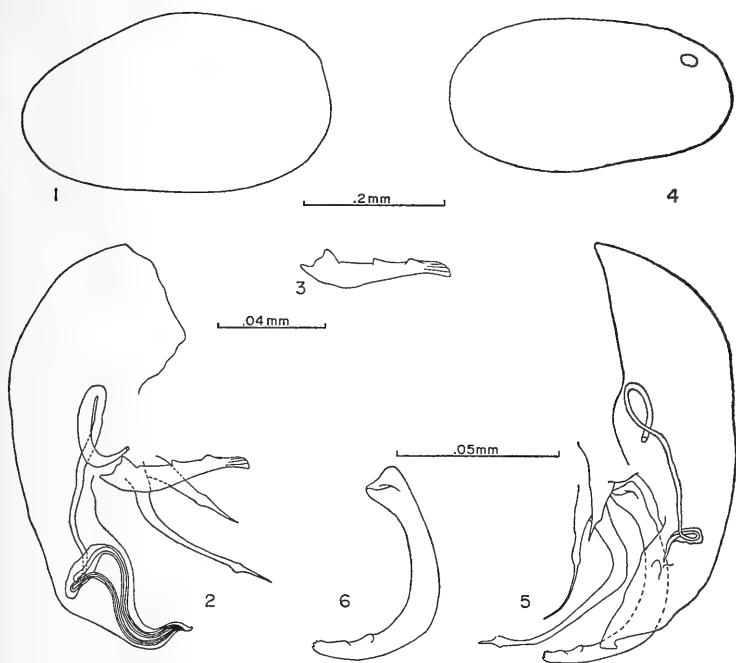
Two new genera and species of ostracods epizootic on crayfishes are described from Kentucky and South Carolina. A single specimen of *Plectocythere crotaphis* was taken from the burrowing crayfish, *Cambarus carolinus*, in Bell County, Kentucky. This ostracod is unusual in that each peniferum of the male is provided with two penis-like structures instead of the usual one. It has not been possible with the single specimen available to associate the ventral one, here designated the prostatic element, with the sperm duct, and perhaps only the dorsal one, the spermatic element, is functional as an organ of sperm transfer. An understanding of the relationship between the two must await the acquisition of a sufficiently large series of specimens for sectioning. Only *Ascetocythere asceta* (Hobbs and Walton, 1962) and *Cymocythere phyma* (*ibid.*) have been observed to have a similar penis complex, and while both were illustrated, the authors did not refer to the two elements in their descriptions.

Harpagocythere georgiae is not obviously closely allied to any other member of the family but shares with the members of the genus *Dactylocythere* a finger guard; its peniferum resembles, to some degree, that of *D. leptophylax* (Crawford, 1961) but the latter has a peculiar fold on the anteroventral portion and a strongly recurved, distally expanded clasping apparatus. The clasping apparatus of *H. georgiae* resembles that of members of the genus *Uncinocythere* (Hart, 1962) but is distinct.

The following key will provide for the identifications of the two new monotypic genera described herein.

A KEY TO THE GENERA OF THE FAMILY ENTOCYTHERIDAE
(modified from Hart, 1962)

1. Finger guard present 2
- 1'. Finger guard absent 5
- 2(1). Peniferum with accessory groove except in *D. leptophylax* in which the finger guard is slender and trifid 3
- 2'. Peniferum without accessory groove; finger guard never slender and trifid 4
- 3(2). Posteroventral portion of peniferum ending in a barbed point *Sagittocythere*
- 3'. Posteroventral portion of peniferum variable but never ending in a barbed point *Dactylocythere*
- 4(2'). Distal portion of peniferum bulbiform, clasping apparatus never extending so far ventrally as peniferum *Cymocythere*
- 4'. Distal portion of peniferum slender, terminating in a small recurved projection, clasping apparatus extending ventrally beyond peniferum *Harpagocythere*
- 5(1'). External border of clasping apparatus with a talon or excrescence *Ankylocythere*
- 5'. External border of clasping apparatus entire 6
- 6(5'). Internal border of clasping apparatus with more than three teeth, apical cluster with more than two denticles, and vertical ramus straight 7
- 6'. Internal border of clasping apparatus usually with no more than three teeth; if more than three, with only two apical denticles or vertical ramus strongly convex posteriorly 8
- 7(6). Distal portion of peniferum slender and heavily cornified *Rhadinocythere*
- 7'. Distal portion of peniferum neither slender nor cornified *Entocythere*
- 8(6'). Peniferum with a subterminal bulbous expansion bearing one or more terminal projections and penis with separate spermatid and prostatic elements 9
- 8'. Peniferum never with a subterminal bulbous expansion and penis simple or with contiguous spermatid and prostatic elements 10
- 9(8). Distalmost portion of peniferum tapering to apex with tip of penis reaching apex *Plectocythere*
- 9'. Distalmost portion of peniferum bearing a phalange and with penis emerging proximal to it *Ascetocythere*
- 10(8'). Clasping apparatus reaching ventrally almost or as far ventrally as does peniferum 11



FIGS. 1-3. *Plectocythere crotaphis*, new species. Fig. 1. Shell of holotypic male. Fig. 2. Copulatory complex of holotypic male. Fig. 3. Clasper of holotypic male. FIGS. 4-6. *Harpagocythere georgiae*, new species. Fig. 4. Shell of holotypic male. Fig. 5. Copulatory complex of holotypic male. Fig. 6. Clasper of holotypic male.

- 10'. Clasper apparatus not reaching nearly so far ventrally as does peniferum *Geocythere*
 11(10). Penis heavily cornified and always longer than half length of distal portion of peniferum (from level of base of clasper apparatus distally) *Donnaldsoncythere*
 11'. Penis seldom heavily cornified and never more than half length of distal portion of peniferum *Uncinocythere*

Plectocythere, new genus

Etymology: *Plectocythere* (feminine)—*Plectus* (Gr.), twisted; so named because of the curved ventral extremity of the peniferum.

Diagnosis: Terminal tooth of mandible with cusps. Copulatory complex of male without finger guard; ventral portion of peniferum bulbous, terminating in a small, slender, curving projection; penis consisting of separate spermatic and prostatic elements that are not contiguous along

most of their courses, each element as long as, or longer than, claspings apparatus and reaching ventral extremity of peniferum; accessory groove absent; external border of claspings apparatus entire, internal border with two prominences, apex with four small, rounded scallops.

Type-species: Plectocythere crotaphis, new species

***Plectocythere crotaphis*, new species**

(Figs. 1-3)

Etymology: crotaphis (Gr.), a pointed hammer; referring to the peniferum.

Male: Eye lacking. Shell (Fig. 1) ovate with ventral margin entire; greatest height slightly anterior to midlength. Length 0.420 mm, height 0.259 mm. Submarginal setae widely spaced anteriorly, posteriorly, and ventrally, absent dorsally. Terminal tooth of mandible with cusps.

Copulatory complex (Figs. 2 and 3)—As described in the generic diagnosis. Dorsal finger broad at base and two-thirds as long as slender ventral finger, the latter slightly curved at distal end of basal third. Claspings apparatus not clearly divisible into horizontal and vertical rami; short basal portion proximal to bend probably corresponds to vertical ramus.

Female: Unknown.

Type-locality: Crayfish burrow in a cultivated area near a small spring about 11 mi. NE junction of U. S. Hwy. 25E. and U. S. Hwy. 119 on Hwy. 119, Bell County, Kentucky.

Host: Cambarus carolinus Erichson (determined by Horton H. Hobbs, Jr.).

Holotype: Male, the only specimen known, has been placed in the United States National Museum (no. 111264).

Relationships: This species has its closest relationship with *Ascetocythere asceta*. The peniferum of each bears a subterminal bulbous expansion from which a pair of prominent slender penes extend ventrally to its apex and lacks an accessory groove. The claspings apparatus of each bears two teeth on the internal border of its distal half and the apex is without distinct denticles. The vertical ramus is less than one-fourth of the total length of the claspings apparatus.

***Harpagocythere*, new genus**

Etymology: Harpagocythere (feminine)—*Harpago* (Gr.), hook; so named because of the recurved ventral projection of the peniferum.

Diagnosis: Terminal tooth of mandible with cusps. Copulatory complex of male with finger guard; ventral portion of peniferum slender and terminating in a small recurved projection, its ventral margin extending ventrally almost to same level as claspings apparatus; single penis less than one-fifth as long as claspings apparatus and situated op-

posite ventral portion of finger guard; accessory groove absent; external border of clasping apparatus entire, internal border of horizontal ramus with two prominences, apex with four small denticles, the upper one of which is not acute; extensions of horizontal and vertical rami forming an angle of approximately 70°.

Type-species: Harpagocythere georgiae, new species

Harpagocythere georgiae, new species
(Figs. 4-6)

I am pleased to name this species in honor of my mother, Georgia Blount Hobbs.

Male: Eyes present. Shell ovate, ventral margin with a shallow emargination slightly anterior to midlength, greatest height slightly posterior to midlength. Length 0.399 mm, height 0.210 mm. Submarginal setae evenly and widely spaced ventrally and a few posteriorly, absent dorsally and anteriorly. Terminal tooth of mandible with cusps.

Copulatory complex (Figs. 5 and 6)—As described in the generic diagnosis. Dorsal and ventral fingers slender; ventral finger strongly curved at distal end of proximal third. Finger guard less than half length of clasping apparatus with an acute terminal projection, the latter sometimes with a small posterior tooth at base.

Female: Unknown.

Type-locality: Crayfish burrow and stream in a small ravine, about 1.0 mi E Saluda River, and about 0.5 mi N State Rte. 183 on surfaced unnumbered road near Farris Bridge, Greenville County, South Carolina.

Additional locality: Burrow along small spring-fed run, about 5.5 mi NW Greenville, Greenville Co., South Carolina.

Types: The holotype and a dissected male paratype, the only specimens taken at the type locality, are deposited in the United States National Museum (nos. 111262 and 111263). A paratypic male is in the collection of C. W. Hart, Jr.

Hosts: The specimens from the type locality were recovered from the collecting jar containing *Cambarus carolinus* Erichson and *Cambarus latimanus* (LeConte), and the paratype was found on *Cambarus carolinus* (crayfish determinations by Horton H. Hobbs, Jr.).

Relationships: *Harpagocythere georgiae* has its closest affinities with those entocytherids possessing a small penis located high in the peniferum and a finger guard on the copulatory complex (members of the genera *Dactylocythere*, *Sagittocythere*, and *Cymocythere*). In the absence of an accessory groove, it resembles *C. cyma* (Hobbs and Walton, 1960) and *C. phyma* (Hobbs and Walton, 1962). The clasping apparatus is more similar to that of *S. barri* (Hart and Hobbs, 1961) than to that of any species. It differs from all entocytherids in possessing a comparatively slender peniferum with an anteroventral recurved projection. The superficial resemblance of the latter to that of *D. leptophylax* was pointed out above.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF *ELEUTHERODACTYLUS*
(AMPHIBIA: LEPTODACTYLIDAE) FROM THE
SIERRA DE BAORUCO, REPÚBLICA DOMINICANA

BY ALBERT SCHWARTZ

Among novelties collected by David C. Leber and Richard Thomas during the summer of 1964 in the Sierra de Baoruco in the República Dominicana is a unique *Eleutherodactylus*. Although frogs of this genus were collected in the Baoruco by W. G. Hassler in late 1929 and early 1930 with the subsequent description of two new forms (*armstrongi*, *rufifemoralis*), (Noble and Hassler, 1933) the recent collection not only of the present novelty but of another large species, allied to *E. ruthae*, indicates that the amphibian fauna of the Baoruco is still rather sketchily known. This is due in part to the relative inaccessibility of much of the range except for the Valle de Polo region, which unfortunately does not lie at really high elevations. As more collecting is done in the higher portions of this range above 4000 feet, it is likely that there will not only be additional new species discovered but also that various of the Massif de la Selle amphibians will be encountered in the Sierra de Baoruco.

I wish to thank Messrs. Thomas and Leber for their endeavors on my behalf in this region, and Mr. Leber as well for making the illustration for the present paper. Mr. Charles M. Bogert and Miss Margaret Bullitt generously supplied me with specimens of *E. rufifemoralis* for comparative purposes. The new frog may be known as

***Eleutherodactylus neodreptus*, new species**

Type: MCZ 43207, a gravid female, from 24 km SW Barahona, Barahona Province, República Dominicana, 3700 feet, taken 6 July 1964 by David C. Leber. Original number V2867.

Diagnosis: A small, stocky species of *Eleutherodactylus* with a gran-

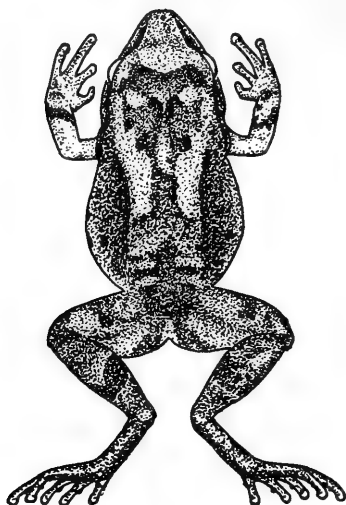


FIG. 1. *Eleutherodactylus neodreptus*, MCZ 43207, type, snout-vent length 20.2 mm; 24 km SW Barahona, Barahona Province, República Dominicana, 3700 feet.

ular venter, small digital discs, short hind limbs, patch-like vomerine series, unspotted venter, single femoral and crural bars, a distinctive dorsal pattern, and without inguinal glands.

Description of type: A gravid female with the following measurements (in millimeters) and ratio: snout-vent length, 20.2; distance from snout to posterior border of tympanum, 7.0; head width, 6.8; longitudinal diameter of tympanum, 1.1; longitudinal diameter of eye, 2.4; naris to eye, 2.2; femur, 8.2; tibia, 8.0; fourth toe, 7.2; tibia/snout-vent ratio, 39.6. Head length and width approximately equal; snout rather pointed and slightly truncate, with nares inconspicuous at anterior end of canthus rostralis; diameter of eye slightly more than distance from naris to anterior corner of eye; diameter of tympanum much less than diameter of eye, distance from tympanum to eye almost equal to diameter of tympanum. Interorbital distance 2.7 mm, greater than diameter of eye. Digital discs present, small, those on digits 2, 3 and 4 equal to two-thirds area of the small tympanum. Fingers short, unwebbed, 3-4-2-1 in order of decreasing length; subarticular tubercles pale gray, conspicuous. Toes short and rather stout, unwebbed, 4-3-5-2-1 in order of decreasing length; subarticular tubercles gray, well developed. Heels barely touch when femora are held at right angles to body axis. Inguinal glands absent. Dorsum smooth with low tubercles along the sides which grade gradually into the granular venter. Throat and chest smooth,

belly coarsely granular. Dorsal surface of fore- and hindlimbs smooth to very slightly tuberculate. Posterior and ventral faces of thighs covered with large, conspicuous, juxtaposed flattened granules. Tongue small, free and not notched behind, its greatest width equal to about one-half of that of floor of mouth. Vomerine teeth in two small, almost diagonal, patch-like series, enclosed well within the median margins of the choanae, separated from them by a distance equal to the length of one tooth row, the two rows separated medially by a distance equal to one and one-half tooth rows.

Coloration of type: The dorsal coloration consists of varying intensities of brown and tan in an elaborate and complex pattern (see Figure 1), as follows. General dorsal coloration dark brown with a pair of short tan reversed parentheses, with irregular edges along the anterior borders, and extending onto the scapular region, enclosing between themselves a slightly asymmetrical small tan longitudinal blotch which is appressed to and almost joined with the right parenthesis. A pale tan preocular bar involving the anterior third of the upper eyelids, followed by a dark interocular bar which becomes paler posteriorly and has its pale posterior border edged with very dark brown, thus setting the entire interocular complex off from the balance of the dorsum and leaving a vaguely double triangular figure enclosed between the parentheses and their concomitant median blotch and the pale posterior edge of the dark interocular bar. Snout brown, slightly darker than the preocular bar. Posterior dorsum dark brown, irregularly and inconspicuously marked with paler. Hindlimbs brown with a single darker brown femoral and crural transverse bar, poorly outlined in tan, and a vague indication of a transverse dark bar on the pes. Pale forelimbs with a single dark brown bar on the antebrachium. Concealed surfaces of the thighs dark brown. A dark brown canthal line which crosses the eye and extends rather far posteriorly to above the forelimb insertion. Ventral surfaces creamy with brown stippling concentrated on the throat and hindlimbs, but present as well over the entire belly; the ventral stippling does not form any pattern.

Comparisons: At the type locality of *E. neodreptus* have been taken the species *rufifemoralis* Noble and Hassler, *armstrongi* Noble and Hassler, *abbotti* Cochran, *inoptatus* Barbour, and *heminota* Shreve and Williams (the latter is the first record of this more western species in the República Dominicana). From the smaller four species (*rufifemoralis*, *armstrongi*, *abbotti*, *heminota*) *neodreptus* can be distinguished by smaller discs, both actually and relatively (*armstrongi* and *heminota* both have large discs), from all four species by stockier habitus, from *rufifemoralis* by larger size and absence of dark brown ventral pattern (see Cochran, 1941, Fig. 16, p. 53). Compared with the very large *inoptatus* (snout-vent length to 88 mm), *neodreptus* is much smaller. From all the above species, *neodreptus* differs strikingly in pattern. Although the two species are not closely allied, a detailed comparison with *rufifemor-*

alis may be the most pertinent. Six adult females of *rufifemoralis* show the following measurements (means and extremes): snout-vent length, 16.9 (15.3-17.7); head length, 6.3 (5.8-7.0); head width, 6.1 (5.9-6.5); tympanum, 1.3 (1.2-1.4); eye, 2.2 (2.0-2.4); naris to eye, 1.5 (1.3-2.0); femur, 7.9 (7.3-8.5); tibia, 8.0 (7.7-8.4); fourth toe, 7.6 (7.4-8.0); tibia/snout-vent length ratio, 47.5 (45.2-50.3). From these data it can be determined that *neodreptus* is slightly larger than female *rufifemoralis*, has a smaller tympanum, longer snout, and shorter fourth toe. The tibia/snout-vent ratio of *neodreptus* (39.6) is lower than similar ratios for female *rufifemoralis*. Additionally, the new species lacks the ventral pattern and red concealed surface coloration of *rufifemoralis*; the latter species likewise has a smooth venter and highly tubercular hindlimbs, and two dark crural crossbars—all features which *neodreptus* lacks.

The affinities of *neodreptus* are extremely uncertain. The combination of characters such as granular venter, digital discs, and short vomerine series would seem to ally it to the *auriculatus* assemblage. However, the habitus of the animal is quite different from all other members of this group in the West Indies. In build it much more resembles the upland members of the *dimidiatus* group in Hispaniola (*jugans*, *ventrilineatus*, *parabates*), but differs from them in slimmer and more pointed head. From the widespread and conglomerate *ricordi* group, which includes the majority of West Indian *Eleutherodactylus*, *neodreptus* differs in having a granular belly (although some *ricordi* members do have a granular belly, *i.e.*, *gundlachi* and *linikowskii*), well-developed discs on all four fingers (usually *ricordi* members have the discs on fingers 3 and 4 larger and better developed than those of fingers 1 and 2), short and patch-like, rather than long, vomerine series (although this is an extremely variable character throughout the group), and a smooth rather than rugose dorsum. For the moment, pending acquisition of additional material, the affiliations of *E. neodreptus* must be held in abeyance.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NOTURUS MUNITUS, A NEW SPECIES OF MADTOM,
FAMILY ICTALURIDAE, FROM SOUTHERN
UNITED STATES

BY ROYAL D. SUTTKUS¹ AND WILLIAM RALPH TAYLOR

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The first known collection of the new madtom was obtained from the Pearl River in 1950. Extensive collecting during subsequent years suggested to us that it was the sole endemic fish species in this system, but more recent collections show that it is more widely distributed. A total of 1,979 specimens was available for this study, of which seven are from the Cahaba River in Alabama, two from the Tombigbee River and the remainder from the Pearl River system in Louisiana and Mississippi.

The most recent description of a madtom was by Bailey and Taylor (1950). Several other undescribed forms are known to Taylor, descriptions of which are planned soon after publication of this paper.

The authors thank the students and faculty of Tulane University, and others for assistance in the collecting. We wish especially to acknowledge the frequent aid of Paul K. Anderson, Myrna Andersson, Clyde D. Barbour, Gerald E. Gunning, Rudolph J. Miller, Kristin T. Nielsen, John S. Ramsey, Jayson S. Suttkus and Jamie E. Thomerson. We are also indebted to Fanny Phillips who assisted us in preparing the illustrations and to C. A. Schultz, Mississippi Game and Fish Commission, who lent us the specimens from the Tombigbee River.

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FIG. 1. *Noturus munitus*, USNM 197708, paratype, male, 46.1 mm in standard length. Photographed by University of Michigan Photographic Services.

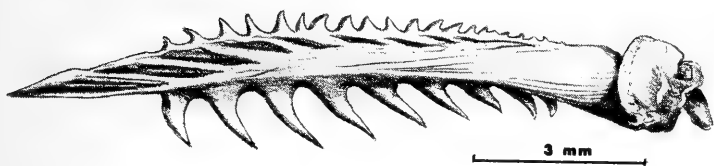


FIG. 2. Left pectoral spine of a female *Noturus munitus*, 44 mm in standard length, USNM 197708. Drawn by W. L. Brudon.

We recognize the new species as a member of the subgenus *Rabida* Jordan and Evermann. The characters of the subgenus are a mottled or blotched pattern, often forming prominent saddles on the back, and serrations along both the anterior and posterior edges of the pectoral spine (Fig. 2). The anterior spine serrae are small. The posterior serrae are larger and uniformly curved toward the body except one, or sometimes two, near the spine base. Other species in the subgenus *Rabida* are *Noturus eleutherus* Jordan, *Noturus furiosus* Jordan and Meek, *Noturus hildebrandi* (Bailey and Taylor) and *Noturus miurus* Jordan. *Schilbeodes gallowayi* Fowler is a synonym of *Noturus eleutherus*, as noted by Bailey and Taylor (1950: 31).

***Noturus munitus*, new species**

Frecklebelly Madtom.

(Figs. 1-3)

Holotype: Tulane University no. 26250, a male 50.5 mm in standard length, collected from the Pearl River, 2.6 miles east of Sandy Hook, Marion County, Mississippi, November 14, 1955, by Royal D. Suttkus and Kristin T. Nielsen.

Paratopotypes: Tulane University no. 11311, totaling 326 specimens, 26 to 53 mm in standard length, bearing same data as the holotype, now distributed as follows: Academy of Natural Sciences, Philadelphia, no. 102047, 10 specimens; British Museum of Natural History, no. 1964.12.24.1-10, 10 specimens; Chicago Natural History Museum, no. 72742, 10 specimens; Cornell University, no. 47676, 25 specimens; Museum of Comparative Zoology, no. 43090, 10 specimens; Museum National d'Histoire Naturelle, Paris, no. 1964-584, 5 specimens; Senckenbergische Naturforschende Gesellschaft, Frankfurt am Main, no. SMF 7580-7584, 5 specimens; Stanford University, no. 62400, 5 specimens; Tulane University, 196 specimens; University of Michigan, Museum of Zoology, no.

181771, 25 specimens; United States National Museum, no. 198208, 25 specimens.

Other paratopotypes: Pearl R., 2.6 mi E Sandy Hook, Marion Co., Mississippi, USNM 197708, formerly TU 1844 (23 specimens, 22–46 mm) 24–25 Nov. 1951; TU 3557 (8, 25–51) 16 Feb. 1952; TU 13954 (213, 23–51) 5 Oct. 1956; TU 14930 (82, 23–54) 12–13 Jan. 1957; TU 14938 (82, 22–48) 6 Jan. 1957; TU 15171 (92, 25–52) 22–23 Jan. 1957; TU 18963 (60, 23–51) 3 Nov. 1957; TU 22824 (38, 26–55) 26 Oct. 1959; TU 23127 (1, 40) 24 Mar. 1960; TU 26657 (87, 20–55) 20 Oct. 1961; TU 28403 (16, 22–49) 19 Oct. 1962; TU 28719 (30, 23–53) 21 Oct. 1961; TU 28768 (129, 23–57) 28 Dec. 1962.

Other paratypes: Pearl River system.—Pearl R., 4 mi NE Sandy Hook, Marion Co., Mississippi, TU 3627 (68, 24–48) 13 Jan. 1952. Upper Little Cr., Hwy. 13, 5 mi SE Columbia, Marion Co., Mississippi, TU 3951 (11, 32–52) 23 May 1952; TU 9709 (3, 41–50) 30 June 1954. Ten Mile Cr., Hwy. 35, 4.3 mi S Foxworth or 9.7 mi N Sandy Hook, Marion Co., Mississippi, TU 4872 (1, 55) 19 Aug. 1951; TU 16148 (6, 42–59) 7 Aug. 1957; TU 17951 (1, 49) 3 May 1958. Pushepatapa Cr., Hwy. 21, 0.2 mi S Varnado or 7.0 mi N Bogalusa, Washington Parish, Louisiana, TU 7369 (1, 67) 19 Jan. 1952; TU 10462 (3, 39–52) 29 June 1955; TU 11588 (1, 54) 7 May 1956; TU 15073 (2, 61–78) 13 Jan. 1957; TU 15465 (2, 38–48) 21 Apr. 1957; TU 17472 (1, 67) 20 Mar. 1958. Trib. to Pearl R., 0.5 mi S Hub, Marion Co., Mississippi, TU 8886 (4, 33–60) 28 Oct. 1950. Strong R., Hwy. 26, formerly Hwy. 20, 2.3 mi W Pinola, Simpson Co., Mississippi, TU 17721 (4, 34–44) 3 Apr. 1958; TU 18739 (2, both 54) 3 July 1958; TU 19781 (9, 24–67) 8 May 1959; TU 28820 (14, 31–75) 29 Dec. 1962; TU 30149 (32, 22–77) 6 Nov. 1963. Bogue Chitto R., Hwy. 438, 1 mi W Warnerton, Washington Parish, Louisiana, TU 19825 (52, 25–75) 2 May 1959; TU 19880 (3, 44–73) 3 May 1959; TU 23351 (1, 41) 3 July 1960. Bogue Chitto R., Hwy. 437, 1 mi S Enon, Washington Parish, Louisiana, TU 23310 (1, 26) 3 July 1960. Copiah Cr., Hwy. 27, 2.4 mi S Georgetown, Copiah Co., Mississippi, TU 23518 (24, 24–54) 22 July 1960; TU 23869 (3, 53–55) 25 Nov. 1960. Trib. to Pearl R., Hwy. 35, 0.5 mi N Marion Co. line, Marion Co., Mississippi, TU 23701 (1, 40) 21 July 1960. Holidays Cr., Hwy. 13, 0.5 mi S Goss, Marion Co., Mississippi, TU 26695 (1, 53) 21 Oct. 1961. Fair R., Hwy. 27, 4.5 mi N Monticello, Lawrence Co., Mississippi, TU 26759 (11, 40–62) 3 Nov. 1961. Silver Cr., Hwy. 587, northern limit Morgantown, Marion Co., Miss., TU 26878 (1, 75) 9 Dec. 1961. Pearl R., 2.5 mi S Oakville, Lawrence Co., Mississippi, TU 27137 (5, 16–32) 29 Aug. 1962. Pearl R., 1.5 mi SE Morgantown, Marion Co., Mississippi, TU 27172 (18, 20–39) 30 Aug. 1962. Bahala Cr., Hwy. 27, 6 mi S Rockport, Lawrence Co., Mississippi, TU 27299 (12, 31–49) 28 Oct. 1961. Pearl R., 1.5 mi SE Foxworth, Marion Co., Mississippi, TU 28034 (87, 26–54) 1 Dec. 1962; TU 28272 (47, 27–48) 17 Oct. 1962; TU 28534 (240, 22–58) 19–20 Dec. 1962. Pearl R., 3 mi SE Foxworth, Marion Co., Mississippi, TU 28303 (4, 29–46)

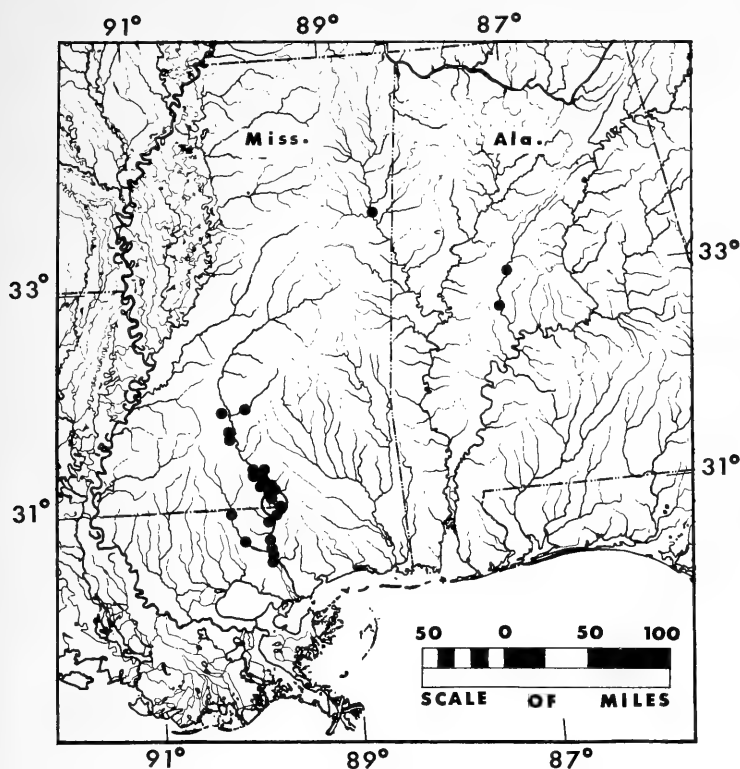


FIG. 3. Collection sites of *Noturus munitus*. The large circle indicates the type locality.

18 Oct. 1962. Pearl R., just above mouth of Ten Mile Cr., 6 mi SE Foxworth, Marion Co., Mississippi, TU 28316 (13, 28–52) 18 Oct. 1962. Pearl R., 0.5 mi upstream from Hurricane Cr. or 4 mi NNE Sandy Hook, Marion Co., Mississippi, TU 28345 (10, 24–46) 18 Oct. 1962. Pearl R., 2 mi NE Sandy Hook, Marion Co., Mississippi, TU 28373 (7, 26–45) 18 Oct. 1962. Pearl R., 1.5 mi NE Sandy Hook, Marion Co., Mississippi, TU 28391 (23, 33–47) 19 Oct. 1962. Pearl R., 4 mi E Angie, Washington Parish, Louisiana, TU 28429 (24, 25–45) 19 Oct. 1962. Pearl R., just below Pools Bluff Sill, 4 mi S Bogalusa, Washington Parish, Louisiana, TU 29942 (5, 17–37) 30–31 Aug. 1963; TU 30010 (17, 22–41) 29 Sept. 1963; TU 30040 (2, both 38) 25 Oct. 1963. Pearl R., river mile 52, 0.3 mi below mouth McGehee Cr., St. Tammany Parish, Louisiana, TU 29962 (1, 25) 10 Sept. 1963; TU 30025 (2, 29–32) 10 Oct. 1963. Pearl R., river mile 46, St. Tammany Parish, Louisiana, TU 29975 (1,

TABLE 1. Measurements¹ of *Noturus munitus* expressed as thousandths of the standard length

| Sex | Holotype TU 26250 | Paratopotypes TU 11311 | | | | | Mean |
|---|----------------------|---------------------------|------|------|------|------|------|
| | ♂ | ♂ | ♂ | ♀ | ♀ | ♀ | |
| Standard length (mm) | 50.5 | 51.7 | 49.7 | 53.4 | 36.0 | 38.0 | 46.5 |
| Body depth | 211 | 216 | 209 | 222 | 236 | 223 | 219 |
| Caudal peduncle depth | 106 | 114 | 104 | 101 | 102 | 105 | 105 |
| Snout to dorsal origin | 447 | 448 | 432 | 432 | 433 | 439 | 438 |
| Snout to pelvic origin | 546 | 541 | 539 | 541 | 536 | 534 | 539 |
| Snout to anal origin | 685 | 686 | 669 | 683 | 680 | 686 | 681 |
| Dorsal origin to adipose origin | 295 | 297 | 299 | 280 | 308 | 276 | 292 |
| Dorsal origin to adipose tip ² | 498 | 491 | 494 | 494 | 555 | 505 | 506 |
| Adipose notch to tip of caudal | 318 | 330 | 331 | 314 | 324 | 328 | 324 |
| Anal origin to caudal base | 310 | 311 | 317 | 299 | 325 | 294 | 309 |
| Caudal peduncle length | 162 | 164 | 162 | 170 | 174 | 165 | 166 |
| Highest dorsal ray | 172 | 199 | 189 | 170 | 197 | 223 | 191 |
| Dorsal spine length | 178 | 183 | 187 | 155 | 177 | 205 | 180 |
| Adipose length | 227 | 224 | 221 | 239 | 258 | 231 | 233 |
| Adipose height | 43 | 46 | 48 | 46 | 55 | 52 | 48 |
| Caudal length | 235 | 224 | 227 | 220 | 247 | 244 | 232 |
| Anal base | 140 | 141 | 140 | 127 | 169 | 157 | 145 |
| Pectoral length | 287 | 297 | 291 | 254 | 299 | 313 | 290 |
| Pectoral spine length | 225 | 245 | 245 | 202 | 241 | 244 | 233 |
| Pelvic length | 178 | 175 | 160 | 166 | 174 | 199 | 175 |
| Posteroceleithral process length | 122 | 123 | 124 | 112 | 127 | 131 | 123 |
| Head length | 366 | 380 | 360 | 346 | 347 | 360 | 359 |
| Head width | 285 | 282 | 259 | 280 | 261 | 265 | 272 |
| Head depth at occiput | 178 | 179 | 177 | 196 | 186 | 178 | 182 |
| Snout length | 142 | 150 | 144 | 144 | 147 | 139 | 144 |
| Orbit length | 73 | 71 | 72 | 73 | 69 | 65 | 70 |
| Mouth width | 194 | 191 | 169 | 179 | 152 | 176 | 176 |
| Nasal barbel length | 93 | 90 | 94 | 99 | 97 | 89 | 93 |
| Maxillary barbel length | 269 | 241 | 251 | 228 | 249 | 270 | 251 |
| Outer mental barbel length | 229 | 205 | 223 | 202 | 219 | 199 | 212 |
| Inner mental barbel length | 166 | 148 | 160 | 147 | 144 | 134 | 149 |

¹ As described in Bailey and Taylor (1950: 33).² The tip of the adipose fin is posterior to the notch or narrow attachment of the adipose and caudal fins.

25) 10 Sept. 1963. West Pearl R., 5 mi SE Talisheek, St. Tammany Parish, Louisiana, TU 29989 (1, 21) 11 Sept. 1963.

Other specimens: Cahaba R., just off Hwy. 5, 2.2 mi N Centerville, Bibb Co., Alabama, TU 15294 (1, 45) 17 Mar. 1957. Cahaba R., Hwy.

14, 1 mi W Sprott or 5 mi E Marion, Perry Co., Alabama, TU 29906 (5, 43-48) 15 Apr. 1963; TU 30101 (1, 52) 2 Nov. 1963. Tombigbee R., 7.5 mi S confluence with Buttahatchie R., Lowndes and Clay counties, Mississippi, from Mr. C. A. Schultz (2, 28-53).

Diagnosis: Posterior margin of adipose fin nearly free from caudal fin; anal fin short, with 12 to 14 rays; caudal fin abbreviated, with 45 to 52 rays; normally 9 pelvic rays, 1,8 pectoral rays, 11 preoperculo-mandibular pores and the infraorbital and supraorbital canals separate anteriorly; body short and chunky, with 30 to 32, seldom 33, vertebrae; caudal peduncle slender; head and spines proportionately large; abdomen, and often bases of pelvic fins, freckled with widely spaced brown chromatophores.

The posterior process of the cleithrum (humeral process) is long as in *Noturus miurus* and *Noturus furiosus*. The dark bar on the adipose fin typically extends to the fin margin, similar to *N. miurus* but unlike *N. eleutherus*. In contrast to both *N. miurus* and *N. furiosus*, there are fewer anal and caudal rays. *Noturus hildebrandi* differs in having fewer pelvic rays, a very short to obscure posterior process of the cleithrum and the bar on the adipose fin confined to the fin base.

Data from holotype: The holotype has 1,6 dorsal rays and iv,9 (equals 13) anal rays. On each side there are i,8 (equals 9) pelvic rays, 1,8 pectoral rays, 11 preoperculo-mandibular pores, 8 posterior serrae on the pectoral spine and 2 pores between the nares indicating that the supraorbital and infraorbital canals are separate anteriorly. The caudal fin has 17 upper simple rays, 7 upper branched rays, 9 lower branched rays and 14 lower simple rays, totaling 47 rays. The head length is stepped 2.9 times in the standard length. Further measurements are given in Table 1.

Description: Body short and heavy, deepest near dorsal fin; caudal peduncle relatively narrow, somewhat constricted below posterior part of adipose fin; head moderately depressed; lower jaw included; eye large, its diameter stepped 1.6 to 2.4 times in snout length; premaxillary tooth patch rectangular, about three times as broad as long, with posterior corners rounded or obtusely angulate; distance from base to tip of posterior process of cleithrum longer than diameter of pectoral spine including its serrae; pectoral spine (Fig. 2) very long and curved; anterior serrae of spine prominent; posterior serrae well developed, relatively few, their number increasing with size of fish, four to eight in specimens 22 to 46 mm in standard length, all except proximal one or two curved toward spine base; dorsal spine long and stiff; adipose fin short and high, its upper margin convex, its posterior end a free rounded to pointed flap, the base narrowly connected to the short pro-current caudal fin membrane; posterior end of caudal fin truncate to slightly rounded.

Excluding the holotype, combined fin-ray counts of 73 specimens from the Pearl River system and one specimen from the Cahaba River

are as follows: caudal fin rays 45(in 4), 46(17), 47(21), 48(23), 49(7), 50(1) and 52(1); of which the upper half of the fins contains 23(8), 24(37), 25(25) or 26(4) rays and the lower half 21(1), 22(23), 23(32), 24(17) or 26(1); 16 to 19, mean 17.5, are upper simple rays; 13, usually 14 to 16, mean 15.0, are branched rays, of which 6, usually 7, mean 6.8, are in the upper caudal lobe and 7 to 9, usually 8, mean 8.2, in the lower; 13 to 17, mean 14.7, are lower simple rays. The dorsal rays are I,5(in 5) or I,6(69); anal rays 12(17), 13(49) or 14(8); pelvic rays 8(1) or 9(73) in left fins and 9(74) in right fins; pectoral rays I,7(4), I,8(69) or I,9(1) in left fins and I,7(8) or I,8(66) in right fins; branchiostegal rays 8 on left and 9 on right in one specimen; preoperculomandibular pores 9(1), 10(5), 11(62) or 12(3) entering left canals and 10(7), 11(62) or 12(2) entering right canals; infra-orbital and supraorbital canals separate anteriorly on both sides of 74 specimens, except on the left side of one. Vertebrae, excluding the anterior fused vertebrae but counting the urostyle as one: Pearl River, 30(in 4), 31(45), 32(15) or 33(1), Cahaba River, 30(4), 31(1) and 32(2). In 39 specimens, 22 to 78 mm in standard length, the head length is stepped into the standard length 2.7 to 3.3 times and the distance from the rear tip of the adipose fin to the tip of the caudal fin into the distance from origin of the dorsal fin to the rear tip of the adipose fin 1.4 to 2.1 times.

Color in preservation: Heavily mottled with dark brown; side light to medium brown; head dark brown above; a dark bar across back of head extending downward through operculum and branchiostegal membrane to lower surface of head; another band passing backward from snout through eye to posterior cephalic band on operculum; postorbital area light; cheek lightly pigmented; upper barbels heavily pigmented; lower barbels, lower lip and side of lower surface of head with scattered pigment; midline of lower surface of head usually immaculate; abdomen and base of pelvic fin with numerous, round brownish chromatophores; a faint brown band crossing abdomen just anterior to pelvic fins; blotches of brown pigment sometimes present on pelvic fin in addition to the brown chromatophores; pectoral fin rather heavily mottled, some blotches present, margin of rays pale yellowish to whitish; anal fin pigmented at base and sometimes with distal and medial dark brown bands, its edge whitish; basal saddle of dorsal fin extending posteriorly to third ray; lower one-half of fin dusted with small chromatophores, followed distally by a relatively clear area, a broad dark brown distal band extending from spine to last dorsal ray and finally with white tips to dorsal spine and soft rays; spine dark brown; caudal fin with two broad dark crescents, one subterminal and one medial, both somewhat connected across upper and lower procurrent rays and tending to form a basicaudal bar; adipose fin dusky anteriorly, with a clear free flap; adipose blotch almost always extending to fin margin; base of dark blotch or saddle at adipose fin not, or but weakly, connected with

other blotches; a rectangular dark saddle, nearly confined to dorsal surface, between dorsal and adipose fins; anterior saddle extending to below lateral line, anteriorly to about midway between dorsal spine and head and posteriorly to third dorsal ray; saddle enclosing or tending to enclose a pair of rather large, light predorsal spots; side adjacent to airbladder dark gray.

Color in life: Color notes were recorded in the field immediately after collecting for two series, taken 29 June 1954 (TU 10462) and 6 November 1963 (TU 30149). The specimens of the former typically had a large sulphur yellow blotch on side of head behind angle of mouth; small dull yellow spot behind each eye; bright yellow area above pectoral base; variously shaped golden yellow blotch just anterior to base of dorsal fin; bright yellow saddle at posterior base of dorsal fin; dull yellow areas behind and extending ventrally on side posterior to yellow saddle; base, anterior part and posterior tip of adipose fin bright yellow; bright yellow oval shaped saddle on dorsal part of caudal peduncle; distal margins of all rayed fins translucent; dorsal fin light yellow basally; caudal fin yellowish, its central portion brightest; anal fin cream colored at base; pectoral fin yellowish basally; pelvic fin light cream color at base grading to translucent distally; ventral surface of head and body whitish, without yellow.

The specimens in the November series were more extensively colored with shades of golden and yellow. The entire dorsal surface and sides were golden; underside of head, inclusive of gill membranes, golden or yellowish; belly whitish; bases of dorsal, caudal and pectoral fins golden, their distal margins translucent or with a faint yellowish tinge in a few individuals; distal part of maxillary barbel white.

Etymology: The name *munitus* (Latin), means armed or protected, and alludes to the large spines and serrae.

Ecology: *Noturus munitus* is an inhabitant of the riffles and rapids of the Pearl River and its larger tributaries. None of the nearly two thousand specimens was taken in still water. Smaller individuals are found in the shallower riffles as well as in the deeper ones with large individuals. Many of the collecting sites in the Pearl River system and the Cahaba have an abundance of river weed, *Podostemum*, especially on exposed bedrock at the Fall Line.

Noturus munitus has been taken with several other species of *Noturus*. *Noturus miurus* Jordan, *N. leptacanthus* Jordan and *N. nocturnus* Jordan and Gilbert are coinhabitants in the Pearl River. *Noturus funebris* Gilbert and Swain is occasionally taken with *N. munitus* in the moderate size tributaries but seldom in the main river. *Noturus gyrinus* (Mitchill), which lives in adjacent still waters in the Pearl River system, usually over silted bottoms, has not been collected with *N. munitus*. *Noturus miurus*, although often found with *N. munitus*, is usually more abundant in the slower flowing parts of the riffle and rapid areas. Moreover, it seems to prefer the silt covered sandbars and detritus covered areas im-

mediately below the rapids of the Strong River, west of Pinola, Mississippi.

Relationship: *Noturus munitus* appears to be most closely related to *Noturus furiosus* which is confined to the distant Tar and Neuse rivers of North Carolina. The two exhibit similarities in body shape, general color pattern and in the structure of the pectoral spine and cleithrum. Together they and some undescribed species form the *furiosus* species group.

Distribution: *Noturus munitus* has been collected from many localities along the central portion of the Pearl River system, from one locality in the Tombigbee River, and from two in the Cahaba River (Fig. 3). We postulate that its actual range is from the Pearl River eastward to the Alabama River system. Its apparent spotty distribution, combined with its preference for the larger rivers, have contributed to its scarcity in collections.

LITERATURE CITED

- BAILEY, REEVE M. AND WILLIAM RALPH TAYLOR. 1950. *Schilbeodes hildebrandi*, A new Ameiurid catfish from Mississippi, Copeia 1950: 31-38, 2 pls.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NORTH AMERICAN HARPACTICOID COPEPODS
7. A NEW SPECIES OF *STENHELIA* FROM NUWUK
LAKE ON THE ARCTIC COAST OF ALASKA

BY MILDRED STRATTON WILSON

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Anchorage, Alaska and Smithsonian Institution*

The only records of identified marine-brackish harpacticoids of the arctic coast of Alaska are those of Willey (1920) and Mohr *et al.* (1961). Alaskan records of brackish species given in Wilson and Yeatman (1959) are from other regions of Alaska with the exception of *Tachidius spitzbergensis* Oloffson, a record based on specimens from Lake Teshekpuk, a large freshwater lake on the arctic coast east of Barrow, and collections from coastal ponds listed by Reed (1962). The specimens from these records and those of Mohr *et al.* from Nuwuk Lake were all identified by M. S. Wilson. The description of one of the species found in Nuwuk Lake is presented here. Taxonomic accounts of some of the other species will be presented in other numbers of this series of papers.

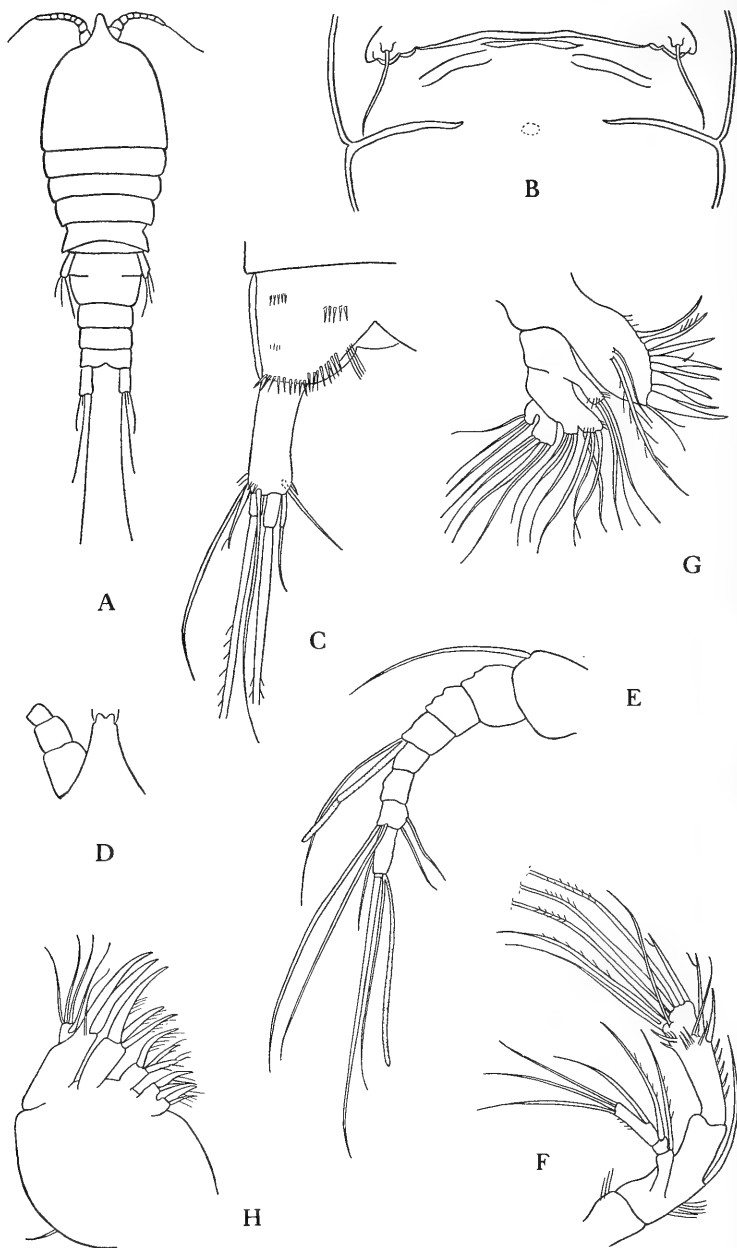
FAMILY DIOSACCIDAE

Stenhelia nuwukensis, new species
Figs. A-N

Stenhelia (Delavalia) sp.: Mohr *et al.*, 1961: 221 (Table 3).

Occurrence: 3 nonovigerous females, from bottom sample, Nuwuk Lake, Point Barrow, Alaska (71°23'N, 156°28'W); 11 August 1960; Roger W. Lewis, collector. Holotype (alcoholic), USNM no. 111293.

Definition: Subgenus *Delavalia* (leg 1: endopod 2-segmented; exopod 2 with inner seta). Leg 1: Exopod 3 with 4 spines and setae; endopod 2 with 4 spines and setae, segment and armature modified as described in detail below. Antennule 8-segmented. Maxilliped prehensile, the apex developed as a slender, divided claw that reaches backwards to base of preceding segment. Setal formula of legs 2-4 like that of *S.*



aemula (as given by Lang, 1948: 593). Leg 5: Exopod directed posteriorly, with 5 setae; basal expansion with 4 setae. (δ unknown.)

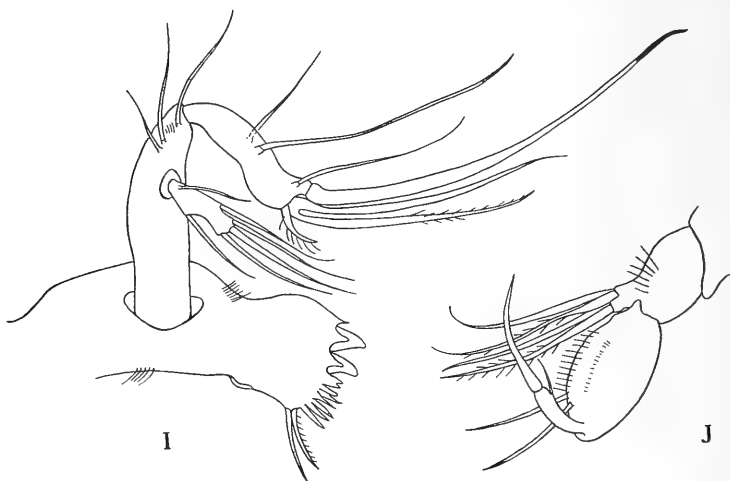
Description (φ): Length (dorsal midline from base of rostrum to end of caudal rami): range of 3 specimens, 1.0–1.24 mm. Anterior and posterior parts of body subequal in length (Fig. A). Genital segment partially divided both ventrally and dorsally by lateral sclerotizations; external genital area defined anteriorly by narrow sclerotization extending nearly across segment and joining the lateral lobes bearing the single seta of leg 6 (Fig. B); copulation pore not visible but position suggested by small oval area at midline between lateral sclerotizations as shown by broken lines in Fig. B (the indefinite external demarcation is perhaps because the specimens are of pre-sexual age as indicated by lack of internal or external ova or attached spermatophores).

Distal margins of all body segments unornamented. Anal segment (Fig. C) ornamented ventrally with irregular groups of scalelike spinules on surface and along bases of caudal rami and medial incision. Caudal ramus (Fig. C) subequal to length of outer margin of anal segment, about $2\frac{1}{2}$ times greatest width (near base); outer margin straight, inner margin incurved. All caudal setae (Figs. A, C) placed apically or subapically, representing what is probably the normal number (7) for the genus, though these are not illustrated in literature for all species. The two setae of outer margin placed subapically, the outermost setiform and about twice length of ramus; the other a shorter, stout spine. Of the three usual apical setae, the two outermost long, stout, jointed at their bases and bearing a few denticles near their middles; second seta the longest, subequal to length of urosome; outer seta reaching beyond middle of second; innermost apical seta also jointed at base, its length less than that of caudal ramus. The usual dorsal seta arising subapically near inner margin of ramus; ventrally, a slender seta placed above base of outer apical seta (Fig. C).

Rostrum (Fig. D) apex slightly indented medially. Antennule (Fig. E) 8-segmented; armed with exceedingly fine, nonplumose setae similar to the few shown in the illustration (because of the extreme fineness, similarity and crowding of the setae, it was found impossible to count precisely the numbers per segment, so a summary of this is omitted); segment 1 with 1 seta; largest number of setae (about 11) on segment

←

FIGS. A–H. *Stenhelia nuwukensis*, n. sp., female. A, Habitus, dorsal view; B, Genital segment, ventral view showing external armature and Leg 6 (greatly enlarged); C, Part of anal segment, caudal ramus and setae, ventral view; D, Rostrum and base of antennule, dorsal view; E, Antennule, with aesthetes and some of setae; F, Antenna (apices of some setae incomplete); G, Maxillule; H, Maxilla. (Figs. C, E, F drawn to same scale; Figs. G, H drawn to same scale as one another but greater than Figs. E–F.)



FIGS. I-J. *Stenhelio nuwukensis*, n. sp., female. I, Mandible; J, Maxilliped (from appendage with anomalous fourth seta on basis). (Figs. drawn to same scale as G-H.)

2; all other segments with at least 3 setae; aesthetes on segments 4 and 8, that of 4 divided at distal third and reaching to end of antennule.

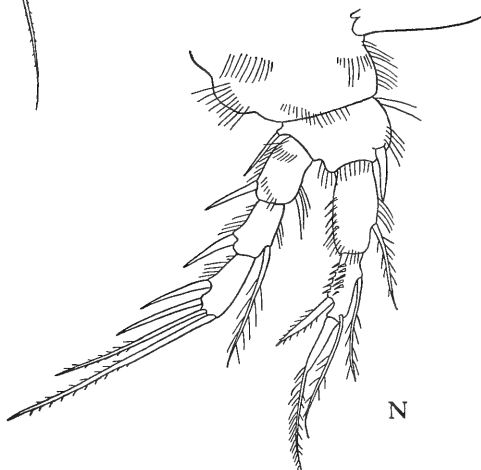
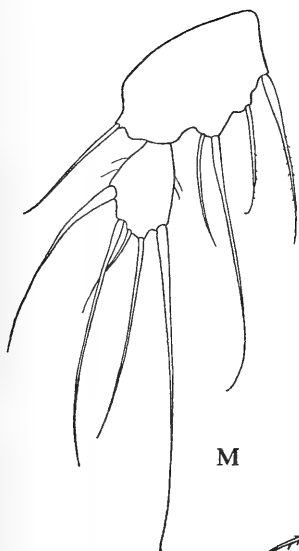
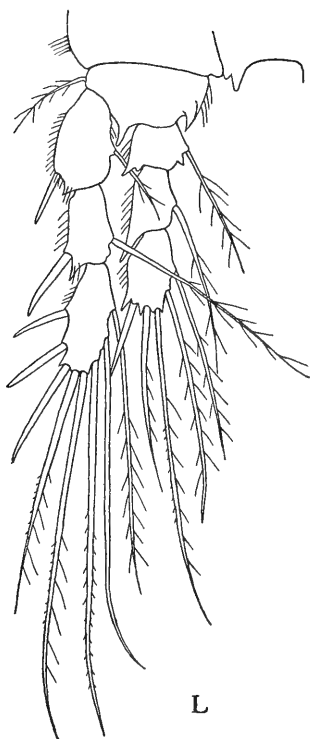
Antenna (Fig. F): The three segments of exopod bearing 1,1,1 lateral and 3 apical setae.

Mandible (Fig. I) largest of cephalic appendages, palp conspicuous even in lateral view of whole specimens. Width of denticles of gnathal lobe of considerable range, edge with 1 or 2 stout, modified setae. Basis of palp elongate, with 3 setae near apex. Exopod unsegmented, shorter than endopod, with 1 outer, 2 inner and 3 apical setae. Endopod elongate, only a little shorter than basis, unsegmented; with 3 inner marginal setae; outer subapical edge with a short stout, plumose seta and 2 setae arising from a common base and exceeding length of endopod; the inner apical edge produced, bearing a heavy unarmed seta exceeding in length the total of the basal and endopod segments.

Maxillule (Fig. G): Gnathal lobe with 10 apical spines and setae and 2 surface setae. Coxa and basis partly separated; lacinia of coxa with 3 setae; basis with 2 laciniae bearing 4 and 3 apical setae. Endopod

→

FIGS. K-N. *Stenhelio nuwukensis*, n. sp., female. K, Leg 2, with outline of inner margin of an endopod segment 1 bearing a second anomalous seta; L, Leg 4; M, Leg 5; N, Leg 1. (Figs. drawn to same scale as one another and like that of Figs. C, E, F.)



and exopod fused at bases but the apices well divided, with 4 and 3 apical setae. Setae naked or with hardly discernible fine short hairs (not shown in figure).

Maxilla (Fig. H) with 4 endites bearing stout, modified clawlike setae; number of setae of proximal to distal endite: 4,3,3,3. Distal endite with well-developed lobe (endopod?) bearing 4 setae.

Maxilliped (Fig. J): Basis with 3 long, inner apical setae (or an anomalous fourth seta as shown in figure). Terminal claw slender but well-developed, the whole reaching back to base of preceding segment; basal part divided near proximal third and bearing a slender inner seta.

Leg 1 (Fig. N): Rami separated by a very wide, narrow intercoxal plate, nearly equaling the width of coxopodite. Exopod 3 with 2 lateral spines and 2 apical setae. Endopod a little shorter than exopod in actual length, reaching little beyond middle of exopod 3; segment 1 wider and a little longer than segment 2 (about 1:0.7), its seta set near distal fourth of segment; the four setae of segment 2 modified and arranged in a distinctive pattern: a stout spine near apex of outer margin, apex narrowed and forming base for a highly modified seta (its length subequal to endopod, with stout, spinelike base tapered to middle where it abruptly narrows and continues as a fine setiform extension, densely plumose on outer margin), inner margin of segment with 2 slender, plumose setae, the distal set subapically near base of apical seta.

Legs 2-4 (Figs. K, L): Intercoxal plates narrower than in leg 1 so that rami not set far apart. Endopods of legs 2 and 3 reaching to near end of exopod, that of leg 4 to near middle of exopod 3; outer margin of endopod 2 strongly produced in legs 2 and 3. (Fig. K shows an anomalous condition of endopod 1, two setae being present on one side, the other side normal with one seta.) Inner seta of first exopod and endopod segments placed near or little beyond middle of segment in all legs. Inner setae of legs tending to be very slender, progressively longer from legs 2 to 4, those of distal segments of leg 2 being shorter than total rami and those of leg 4 longer. Summary of setation of legs 1-4, outer to inner margin (sp = spine; s = seta; position on segment 3 indicated by the marks - or , : - = separation of outer, apical and inner margins; the , divides spine and setae of apex of endopod 3 which has no outer marginal armature in legs 2-4):

| | Exopod | | | Total | | Endopod | | | Total |
|-------|--------|------|-----------|-------|--|---------|---------|----------|-------|
| | 1 | 2 | 3 | Exo. | | 1 | 2 | 3 | Endo. |
| | | | | 3 | | | | | 3 |
| Leg 1 | sp-0 | sp-s | 2sp-2s | 4 | | 0-s | sp-s-2s | | |
| Leg 2 | sp-s | sp-s | 3sp-2s-2s | 7 | | 0-s | 0-2s | sp,2s- | s 4 |
| Leg 3 | sp-s | sp-s | 3sp-2s-3s | 8 | | 0-s | 0- s | sp,2s-3s | 6 |
| Leg 4 | sp-s | sp-s | 3sp-2s-3s | 8 | | 0-s | 0- s | sp,2s-2s | 5 |

Leg 5 (Fig. M): Exopod directed posteriorly rather than laterally as in some species of the genus; with 5 setae; setae 3 and 4 very fine; the

others stout near bases but tapered to setiform extension; the innermost the longest. Basal expansion not produced beyond base of exopod; with 4 slender setae arranged as in figure, the second the longest.

Taxonomy: Several species of *Stenhelina* have been described from arctic and far northern waters. It is a few of these that *S. nuwukensis* resembles in some of its most distinctive structural characters. The endopod of leg 1 is much like that of *S. (D.) cornuta* Lang, described from waters off King-Karl-Land, Swedish Vorland. However, leg 5 of *S. nuwukensis* is built like that of most other species of the genus while that of *S. cornuta* is structurally unique. *S. nuwukensis* also resembles the arctic-boreal species *S. (D.) longicaudata* Boeck in having an enlarged, modified apical seta on the endopod of leg 1, but differs in the much longer second segment; leg 5 of both species has a similar structure but a different number of exopod setae (6 in *longicaudata*). The elongate terminal claw of the maxilliped of *nuwukensis* is unusual in the genus in which this appendage is variously formed and the apical claw, when present, is not usually strongly developed. It should be noted, however, that many authors have not illustrated this appendage, merely referring to it as prehensile or not, or as in the genus. This is a very unsatisfactory description in a genus with the structural diversity of *Stenhelina*, and I draw attention of taxonomists in the Harpacticoida to the need for detailed description and illustration of this appendage.

Six species are known to me to have been described since Lang's (1948) list. These species, mostly tropical or subtropical in distribution, are listed below with their generalized type localities and known sexes:

- S. (S.) divergens* Nicholls, 1939, ♀, sand of St. Lawrence River, Quebec, Canada
- S. (D.) truncatipes* Sewell, 1940, ♀, Addu Atoll, Indian Ocean
- S. (D.) latisetosa* Sewell, 1940, ♀, Addu Atoll, Indian Ocean
- S. (D.) indica* Krishnaswamy, 1957, ♀, "from the compound ascidian, *Polyclinum indicum* collected at Madras Harbour," Bay of Bengal, India
- S. (D.) elisabethae* Por, 1960, ♀ ♂, Romanian coast of Black Sea; additional description in Por (1964)
- S. (D.) incerta* Por, 1964, ♀ ♂, coast of Israel, eastern Mediterranean Sea

Por (1964) has proposed a new genus *Melima*, for a species *caulerpae* from the coast of Israel, eastern Mediterranean Sea. This genus is closely related to *Stenhelina*, differing only in reduction of the number of setae of legs 1-4 (which I do not consider necessarily justifies erection of a new genus in the Harpacticoida), and lack of modification of legs 2 or 3 of the male. Por calls the endopod of leg 1 "highly aberrant and specialized," but considering the structural modifications found in *Sten-*

helia, this emphasis may be exaggerated. Unfortunately, for critical evaluation by other authors, the oral appendages are not illustrated (see above comment on maxilliped).

Ecology: Descriptions of Nuwuk Lake (or Pond) have been given by Mohr *et al.* (1961) and Holmquist (1963). In 1960, it was located at the extreme tip of Barrow Peninsula, known as Point Barrow, the farthest northern extension of land in Alaska. During a severe storm in early October, 1963, the peninsula was separated by channels cut by the ocean and temporarily, at least (summer, 1964), it is an island. It is not known how long Nuwuk Lake has been isolated from the ocean but at the time of the 1960 collections, it was separated on the north edge by a land barrier of about 45.7 m (Mohr *et al.*, 1961). There was no inlet or outlet; the surface area was about 2.5 ha and maximum depth varied from 5.2–5.64 m. The lake was usually ice-free for two months or less (July–August). Mohr *et al.* (1961) described it as a halocline lake with a persistent marine biota. Surface waters were slightly brackish (about 5–8‰) in 1960 and 1961, and the bottom layer had a salinity much above that of the adjacent sea water (about 60‰). Copepods from 1960 collections are species of marine and brackish waters most of which have varying degrees of euryhalinity within either the genus or species.

The three specimens of *S. nuwukensis*, picked out from a bottom sample of unknown locality and depth, were caked with mud, particularly on the dorsal sides of the body segments. This mud was easily removed after a few weeks in preservative and softening with fluid glycerin. The appendages were for the most part relatively clean. This suggests that although closely associated with bottom mud at some time, there must be considerable movement of the copepod in water, particularly during feeding. The large size of *S. nuwukensis* and its well-developed appendages, especially the stout mandibular palp, would seem to be a hindrance to existence in sand or mud. The species would appear more likely to be similar to bottom-living copepods that, in part, hover close to the sand or mud but do not burrow into it, as suggested for the peculiar calanoid genus *Platycopia* (Wilson, 1946: 2–3).

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PROCEEDINGS
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TYPE DESIGNATIONS FOR *DICLADIA* (EBRIACEAE),
PERIPTERA (BACILLARIOPHYCEAE), *GYMNOCELLA*,
PHAEODACTYLIS AND *PHAEOSPHAERA*
(RADIOLARIA)

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In preparation of the forthcoming Treatise on Invertebrate Paleontology, Part B. Protista 1, Index Nominum Generi-
corum and an annotated index to fossil and Recent silicoflag-
ellates and ebridians, several genera of microscopic marine
organisms were found to lack type species. Type designations
are given here for those genera.

Dicladia Ehrenberg, 1844

Dicladia (Ebriaceae) was described by Ehrenberg in 1844 (a, p. 73) with four included species: *D. capra* Ehrenberg (1844a, pp. 69, 79), *D. capreolus* Ehrenberg (1844a, pp. 69, 79), *D.?* *clathrata* Ehrenberg (1844a, pp. 70, 79) and *D. cervus* Ehrenberg (1844a, pp. 69, 79). *Dicladia* was not originally typified and has not been lectotypified. Ehrenberg in 1844(c) transferred *Dicladia capra* and *D. cervus* to the genus *Periptera*. One of the remaining species *D. capreolus* is based on a resting spore of a species of *Chaetoceros* Ehrenberg (1844b). If *D. capreolus* were to be designated as type, *Dicladia* would be a senior synonym of *Chaetoceros*. If *Dicladia clathrata*, the other originally included species, were designated as the type species of *Dicladia*, this genus would be a senior synonym of *Parathranium* Hovasse (1932). Considering the great number of species in the genus *Chaetoceros* as compared to only eight in *Parathranium*, it would be wiser to pick *Dicladia clathrata* as the type of *Dicladia*, since fewer species would have to be transferred to *Dicladia*. *Dicladia clathrata* Ehrenberg is here designated, therefore, as the type of *Dicladia* Ehrenberg. *Dicladia clathrata* was first illustrated by Ehrenberg (1854) in his *Mikrogeologie* (pl. 18, fig. 100). With *D. clathrata* as type species, *Dicladia* Ehrenberg is now a senior synonym of *Parathranium* Hovasse (1932).

Periptera Ehrenberg, 1844

Periptera, described by Ehrenberg in 1844 (c, p. 263), included the following species: *P. tetracladia* Ehrenberg (1844c, pp. 259, 270), *P. chlamidophora* Ehrenberg (1844c, pp. 259, 271), *P. capra* (Ehrenberg) Ehrenberg (1844c, p. 271, basionym: *Di cladia capra* Ehrenberg, 1844a, pp. 69, 79) and *P. cervus* (Ehrenberg) Ehrenberg (1844c, p. 271, basionym: *Di cladia cervus* Ehrenberg, 1844a, pp. 69, 79). As none of the above-named species has been selected as type, *Periptera tetracladia* Ehrenberg is here designated as the type species of *Periptera* Ehrenberg. *Periptera tetracladia* was first figured by Ehrenberg (1854) in his *Mikrogeologie* (pl. 33, xviii, fig. 9). *Periptera* Ehrenberg (Bacillariophyceae), is a junior homonym of *Periptera* Decandolle (1824, Malvaceae), but as it apparently represents resting spores of a species of *Chaetoceros* Ehrenberg (1844b), it is not renamed.

Gymnocella gen. nov.

Gymnocella (Radiolaria) was proposed by Cachon-Enjumet (1961, p. 220), with two included species: *G. helicoidalis* Cachon-Enjumet (1961, p. 222, pl. 7, fig. h, pl. 10, figs. a, b, pl. 18, figs. c, d, e, g) and *G. tregouboffi* Cachon-Enjumet (1961, p. 221, pl. 7, fig. i, pl. 9, fig. d, pl. 10, figs. c, d, e, pl. 16, fig. j, pl. 18, figs. a, b, f). Because no type species was designated by Cachon-Enjumet, the genus is invalid (International Code of Zoological Nomenclature (ICZN), Art. 13(b)). *Gymnocella* gen. nov. is here validated by the designation of *Gymnocella tregouboffi* Cachon-Enjumet (1961) as its type species. The generic diagnosis of *Gymnocella* is given in Cachon-Enjumet (1961, p. 220).

Phaeodactylis gen. nov.

Phaeodactylis (Radiolaria) was proposed by Cachon-Enjumet (1961, p. 208) with seven included species: *P. fagei* Cachon-Enjumet (1961, p. 211, pl. 12, fig. f, pl. 16, fig. d), *P. hollandei* Cachon-Enjumet (1961, p. 210, pl. 5, fig. a, pl. 12, fig. e, pl. 13, fig. d, pl. 16, figs. a-c), *P. mediterranea* Cachon-Enjumet (1961, p. 210, pl. 12, figs. g, h), *P. micropyla* Cachon-Enjumet (1961, p. 209, pl. 12, fig. c, pl. 15, figs. j, k), *P. nematophora* Cachon-Enjumet (1961, p. 209, pl. 12, fig. d, pl. 15, fig. l), *P. radiata* Cachon-Enjumet (1961, p. 211, pl. 17, figs. g, h) and *P. stellaria* Cachon-Enjumet (1961, p. 209, pl. 12, fig. b, pl. 15, fig. m, n). No type species was designated for *Phaeodactylis* by Cachon-Enjumet; hence the genus is invalid (ICZN Art. 13(b)). *Phaeodactylis* gen. nov. is here validated by designation of a type species: *Phaeodactylis hollandei* Cachon-Enjumet (1961). The generic diagnosis for *Phaeodactylis* is in Cachon-Enjumet (1961, p. 208).

Cachon-Enjumet (1961) described *Phaeodactylis micropyla* on p. 209, and spelled it as *P. micropila* on p. 237. *Phaeodactylis micropyla* is here selected as the valid original spelling.

Phaeosphaera gen. nov.

Phaeosphaera (Radiolaria) was proposed by Cachon-Enjumet (1961, p. 205), with two included species: *P. nucleoelongata* Cachon-Enjumet (1961, p. 206, pl. 9, fig. h, pl. 11, figs. d, e, pl. 13, fig. a, pl. 15, fig. d, pl. 16, fig. f), and *P. pigmaea* (Borgert) Cachon-Enjumet (1961, p. 206, basionym: *Phaeocola pigmaea* Borgert, 1909, p. 288, pl. 22, fig. 1). Neither of these two species was designated as type species; thus the genus is invalid (ICZN Art. 13(b)). *Phaeosphaera* gen. nov. is here validated by designation of *P. nucleoelongata* Cachon-Enjumet as its type species. A diagnosis for *Phaeosphaera* gen. nov. is found in Cachon-Enjumet (1961, p. 205).

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PROCEEDINGS
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TWO NEW CONODONT GENERA FROM THE JOINS
FORMATION (LOWER MIDDLE ORDOVICIAN)
OF OKLAHOMA

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Conodonts have been reported from the Joins Formation of the Arbuckle Mountains, Oklahoma, by Gatchell, 1948; Harris, 1957; and more recently by Harris, 1962, 1964, 1964a. Part of a broad program of the investigation, distribution, and composition of conodont faunas in Ordovician rocks currently being followed at California Research Corporation includes the forms recovered from various strata in Oklahoma. The present study is based on conodonts recovered from continuous samples collected from the base to the top of the Joins Formation by A. R. Loeblich, Jr., along U.S. Highway 77 on the south side of the Arbuckle Mountains, SE 1/4 sec. 24, T.2 S., R.1 E., Carter County, Oklahoma.¹

Harris (1962: 199) described briefly the geologic setting of the Joins Formation along U.S. Highway 77 in the southern Arbuckle Mountains. The Joins is here underlain conformably by the West Spring Creek Limestone of the Arbuckle Group and overlain by the sands of the Oil Creek Formation of the Simpson Group. Harris (*loc. cit.*, p. 200) included the Joins and Oil Creek Formations in the Chazyan Stage, which he assigned to the uppermost Canadian Series. Sweet (1963: 506) questioned this assignment and pointed out that the Joins graptolite fauna was representative of the *Didymograptus bifidus* Zone; moreover, the brachiopods *Desmorthis neva-*

¹ The author gratefully thanks Helen Tappan Loeblich and Alfred R. Loeblich, Jr., who offered aid and suggestions in the method of illustration followed herein. Thanks are also expressed to California Research Corporation for permission to publish this portion of the Ordovician studies.



All photographs are unretouched and are of ammonium chloride-coated specimens. FIG. 1—*Eoneoprioniodus cryptodens* n. gen., n. sp. Holotype. USNM 146268—Joins Formation, 40–45 feet above base: lateral view, showing microdenticles and cylindroidal basal plug ($\times 50$). FIG. 2—*Eoneoprioniodus cryptodens* n. gen., n. sp. Paratype. USNM 146269—Joins Formation, 165–170 feet above base: lateral view, showing tendency for stratigraphically younger specimens to develop antero-lateral shift of anterior keel ($\times 37$). FIGS. 3–6—*Tricladiodus clypeus* n. gen., n. sp. Holotype. USNM 146271—Joins Formation, 0–5 feet above base ($\times 37$). 3) outer lateral view, showing basally expanded plate-like posterior denticle. 4) inner lateral view. 5) oral view, show-

densis and *Anomalorthis* probably placed it in the Whiterock Stage (Berry, 1960; Cooper, 1956; and Amsden, 1957). Strata below the McLish Formation (Marmor of Cooper, 1956, and Chazy of Kay, 1940) classed thusly as Whiterock would, in the sense of the above authors, be pre-Chazy and definitely post-Canadian. Chenoweth and Hansen (1964: 854) indicate a Champlainian assignment for the Joins and Oil Creek.

A review of the historical background of Simpson stratigraphic nomenclature is given in Harris (1957: 10-54) along with a description of the Simpson formations (*loc. cit.*, p. 54-103).

Study of conodonts recovered from the Joins Formation, including topotypes of Harris' (1962) fauna, indicates a strong affinity of the Joins conodonts to those from well-known Lower Middle Ordovician faunas, such as the Dutchtown fauna of Missouri.

Type specimens have been deposited in the United States National Museum (Smithsonian Institution), Division of Invertebrate Paleontology, Washington, D. C.

SYSTEMATIC PALEONTOLOGY

Eoneoprioniodus, new genus

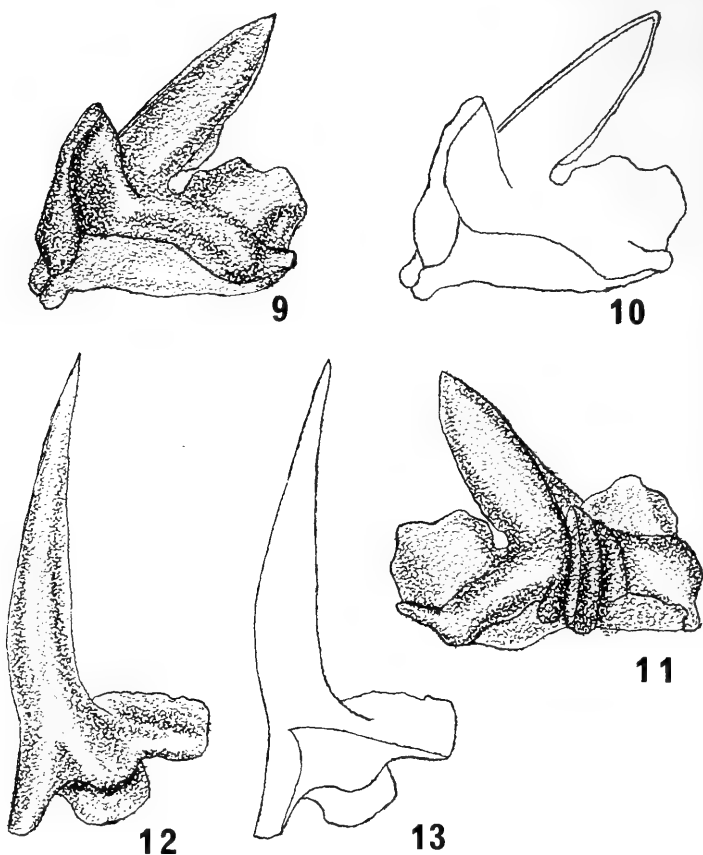
Type species: Eoneoprioniodus cryptodens, new species.

Diagnosis: Simple conodont elements characterized by a drepanodid to scandodid cusp plan, an anterior process produced into an anticusp in the neoprioniodid structural scheme, and a posterior process extending posteriorly as a low quasi-denticulate bar.

Cusp varies from being essentially biconvex, smooth, acostate, and having well-defined anterior and posterior keels, to appearing decidedly asymmetrical and flexed. Posterior keel continues onto oral surface of posterior process as a distinct flange composed of numerous unerupted microdenticles. Anterior keel may be restricted to anterior margin in drepanodid specimens or may migrate to an antero-lateral position above the anticusp. Variations in symmetry are common and undiagnostic.

Basal cavity large and deep, conical in lateral view. Outline of cavity is anteriorly concave upward and posteriorly convex upward.

ing anteriorly flattened cusp face. 6) postero-aboral view, showing pyramidal basal cavity and filling. FIGS. 7, 8—*Tricladiodus clypeus* n. gen., n. sp. Paratypes. USNM 146272, 146273. Both are outer lateral views. Joins Formation. 7) USNM 146272; 0-5 feet above base ($\times 50$). 8) USNM 146273; 15-20 feet above base ($\times 37$).



All figures $\times 47$, camera lucida drawings. FIGS. 9-11—*Tricladiodus clypeus* n. gen., n. sp. Holotype. USNM 146271. 9) inner lateral view. 10) same, showing pyramidal outline of basal cavity. 11) outer lateral view, showing proximal erismoid lip. FIGS. 12, 13—*Eoneoprioniodus cryptodens* n. gen., n. sp. Holotype. USNM 146268. 12) lateral view, showing cylindroid plug. 13) same, showing concavo-convex outline of basal cavity.

Excavation extends over entire aboral surface, continuing to the antero-basal margin of the antiscap. A characteristic cylindroid basal plug of dense, granular material is common to many individuals. Basal margin sinuous, bears a narrow lip.

Remarks: *Eoneoprioniodus* is characterized by its blunt, anteriorly directed antiscap, large and deep basal cavity, posterior bar and pos-

terior keel, microdenticles, anterior keel, sinuous basal margin and cylindroid basal plug.

Eoneoprioniodus most closely resembles some species of *Neoprioniodus* Rhodes and Müller, 1956. It differs from the latter genus by lacking the well-developed denticles on the posterior bar which are so characteristic of *Neoprioniodus*. Most noticeably, *Eoneoprioniodus* possesses a basal cavity of great depth, more closely resembling a drepanodid in the cavity's general concavo-convex lateral outline than the broad, shallow, subapical pit which extends as grooves into neoprioniodid limbs.

Etymology: *Eo*, Gr. *eos*: dawn; refers to the presumed possible ancestry of *Neoprioniodus*.

***Eoneoprioniodus cryptodens*, new species**

(Figs. 1, 2, 12, 13)

Diagnosis: Cusp smooth, flattened, simple, erect to recurved, unequally biconvex, flexed inward, slightly asymmetrical and having a basic scandodid plan. Anterior and posterior edges keeled; anterior margin sinuous in the plane of flattening. Anterior portion produced aborally into an anticusp as an anteriorly directed thick, blunt, prong-like process. Antero-basal margin curved smoothly, joins aboral margin at an abrupt angle. Posterior margin of cusp joins oral surface of base smoothly at an approximate angle of 90°. Posterior process minutely denticulated, developed as a continuation of posterior keel onto distal portion of posterior limb. Keel continues posteriorly as a fringe-like blade with numerous unerupted and partially erupted denticles appearing as surface serrations (microdenticles). Posterior limb is nearly straight but may be bowed inward slightly. Anterior process (anticusp) shorter than posterior bar, lending a "weighted" appearance to the posterior portion.

In lateral view, the basal margin is sinuous, broadly convex upward, and interrupted by a strongly erismodid median portion which is convex downward. A narrow lip serves to reinforce the basal margin.

Basal cavity is extremely deep and greatly excavated, extending from tip of antero-basal junction to postero-basal extremity. In lateral view, the basal cavity is conical in shape, having a strongly concave anterior outline and a gently sloping flatly convex posterior curve. Apex of cavity is a sharp tip, located close to anterior margin. A growth axis is readily observed in some specimens to arise from the tip of the basal cavity to the tip of the cusp. Interlamellar spaces are clearly visible and trace a somewhat erratic growth pattern which is seen to be slightly reflected externally in the expression of the flexed cusp. Basal excavation filled with a cylindroidally shaped plug of granular material.

Remarks: There is a marked tendency for specimens from higher beds to possess an increasingly scandodid scheme of morphology. In these stratigraphically younger specimens, the location of the anterior keel

has shifted over to an antero-lateral position on the inner lateral face of the asymmetrically biconvex cusp. Another variation is found in a group which is not restricted to the younger beds. This latter group possesses a basal cavity of unusually large proportions, occupying nearly the total basal area. In this case, the basal sheath is larger, the basal margin's sinuosity is reduced and the anterior and posterior processes approach equality of length. Either or both of these groups might represent discrete species categories, but the material at hand seems to indicate a gradual set of mixed variations more characteristic of a single species.

Dimensions of holotype: Maximum length, 1.3 mm; basal stretch, 0.5 mm; length of posterior bar, 0.4 mm; length of anticusp, 0.3 mm.

Occurrence: Common in lower Joins strata, rare in upper beds.

Material studied: 106 specimens.

Repository: Holotype, USNM 146268; figured paratype, USNM 146269; unfigured paratypes, USNM 146270.

Etymology: *Crypto-*, Gr. *kryptos*, hidden; *-dens*, L. *dens*, tooth; refers to the unerupted nature of the microdenticles of the posterior bar.

***Tricladiodus*, new genus**

Type species: *Tricladiodus clypeus*, new species

Diagnosis: To this genus belong compound conodonts having a dominant cusp and three denticulated limbs: two antero-lateral and one posterior. The two antero-lateral processes branch off from the main cusp as denticulate bars.

Cusp is characteristically flattened anteriorly and has a lateral carina at each of the anterior margins. Posterior margin of cusp is sharp and bears an indistinct keel. Anterior face of cusp passes aborally and laterally into anterior faces of the two lateral limbs.

The entire unit is subsymmetrical and bowed sharply inward. Each of the three main processes bears a flattened fin-shaped denticle that ornaments a thick, tubular to biconvex bar.

Base expanded, basal margin uniformly convex upward in lateral and anterior views. A deep, pyramidal basal cavity of large proportions extends as deep grooves to the extremities of each process. Apex of basal cavity is located directly beneath the cusp.

Basal cavity of most specimens contains an irregularly shaped mass of dense, granular material.

Remarks: *Tricladiodus* is best characterized by its triangular basal outline, three accessory processes and pyramidal basal cavity.

Tricladiodus most closely resembles *Microcoelodus* Branson and Mehl, 1933, from which entity it differs by possessing an anteriorly flattened main cusp, three distinct denticulated tubular limbs and relatively simple plate-like denticles.

Etymology: *Tri-*, Gr. *trion*, three; *clado-*, Gr. *klados*, branch; *-odus*, Gr. *odous*, tooth; refers to the three denticulate branches or limbs which characterize this genus.

Tricladiodus clypeus, new species
(Figs. 3–11)

Diagnosis: Entire unit subsymmetrical or slightly asymmetrical, consists of two antero-lateral processes and one posterior bar radiating from a conspicuously dominant cusp. Unit is sharply bowed inward.

Cusp stout, pyramidal, triangular in cross-section, reflects the general contour of the basal outline. Anterior face of cusp a flattened curving plane that passes into the anterior faces of the two antero-lateral processes. Posterior margin of cusp is keeled to level of base and posterior bar. Cusp meets base at an angle of about 60° . Lateral faces of cusp are smooth and highly convex.

Posterior process is a thick tapering tubular bar whose distal extremity terminates in an upward flare. A single large plate-like denticle is inclined posteriorly in alignment with cusp. Base of blade-like bar denticle is nearly as long as entire posterior process.

Inner lateral process is a thickened tubular bar bearing one (most commonly) or more fin-shaped biconvex denticles; outer lateral process shorter than inner. One flattened narrowly biconvex denticle extends the length of the latter's tubular bar. Proximal portion of outer lateral bar produced aborally into an erismoid lip.

Basal margin convex upward in lateral and anterior views. Basal cavity moderately deep, pyramidal. In aboral view, basal cavity has the outline of an isosceles triangle with concave sides. Basal excavation continues as deep grooves to extremities of aboral surfaces of processes. Apex of cavity below main cusp.

Remarks: *Tricladiodus clypeus* is characterized by its simple fin-shaped denticles, subsymmetrical disposition of the denticulated processes, and its anteriorly flattened dominant cusp. Variations departing from this basic plan are common in middle Joins strata. Some specimens, possibly representing another species, are most strikingly dissimilar compared to typical *T. clypeus* in the position of the outer lateral process. In these latter cases, the outer lateral process is markedly reduced in size to a degree suggestive of a natural grouping of a different species. In addition, the process is swung forward and the outer lateral costa of the dominant cusp acquires a keel.

Some forms of *Dichognathus* Branson and Mehl, 1933, are similar to *Tricladiodus clypeus*. In species of the former genus, however, the outer anterior lateral process is reduced to the status of an undenticulated anterior bar joined to the outer side of the main cusp.

Tricladiodus clypeus differs from species of *Prioniodus* Pander, 1856, in possessing three equidenticulate processes, each bearing a single fin-shaped denticle. The flattened anterior face of the main cusp of *T. clypeus* also serves to distinguish it from closely allied forms.

Dimensions of holotype: Overall length, 0.8 mm; length of dominant cusp, 0.5 mm; length of posterior denticle, 0.3 mm; basal stretch, 0.7 mm.

Occurrence: Rare in lower Joins strata; restricted to lower 30 feet.

Material studied: 35 specimens.

Repository: Holotype, USNM 146271; figured paratypes, USNM 146272-146273; unfigured paratypes, USNM 146274.

Etymology: *Clypeus*, *L. shield*; refers to the shield-like or fin-shaped biconvex denticles on each of the processes which characterize this species.

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PROCEEDINGS
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THE NORTH AMERICAN SPECIES OF *ELASMUS*
WESTWOOD (HYMENOPTERA, EULOPHIDAE)

BY B. D. BURKS

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In this paper I give a revised key to the North American species of the genus *Elasmus* Westwood, with the description of one new species, and two new synonyms. I have also included a discussion of the reasons for considering the genus *Elasmus* to be the only presently known member of a subfamily Elasminae of the Eulophidae, rather than a distinct family Elasmidae.

A. A. Girault, in a private publication (1918), revised the North American species of *Elasmus* for the first time. The recent catalog of Nearctic Chalcidoidea by Peck (1963: 319-323) lists and gives complete bibliographic citations for all the previously described Nearctic species, with all the published host records. The types of all the described species of North American *Elasmus* are in the U. S. National Museum collection.

The genus *Elasmus* has long been thought to form the distinctive chalcidoid family Elasmidae, principally because *Elasmus* has enormous, flattened hind coxae. This difference makes it very easy to key it out as a family. At one time two other genera, *Euryischia* Riley, 1889, and *Myiocnema* Ashmead, 1900, were also placed in the family Elasmidae because they somewhat resembled *Elasmus* in habitus. They differ fundamentally from *Elasmus*, however, in thoracic structure and in having 5, rather than 4, tarsal segments. Ferrière (1947: 567) was of the opinion that the resemblance of *Euryischia* and *Myiocnema* to *Elasmus* was only convergent, and

Compere (1947: 381) almost simultaneously proposed removing them from the Elasmidae and placing them in close taxonomic association with *Aphelinus* Dalman, 1820. *Euryischia* and *Myiocnema* certainly resemble *Aphelinus* in basic thoracic structure, so their transfer to the Aphelininae (Aphelinidae of many authors) may be accepted without further question. This leaves only *Elasmus* in the Elasmidae.

But is Elasmidae itself a valid family? In a classification made on the basis of similarities, rather than differences, *Elasmus* would be placed in the family Eulophidae. *Elasmus* is distinguished, aside from its coxal character, by having 4-segmented tarsi, the axillae are produced anteriorly almost or quite as far as the bases of the tegulae, the scutellum bears 2 pairs of stout bristles, the female antenna has only 3 funicular segments, the male antenna has 4 funiculars (the basal 3 of which bear lateral branches), and the mandible has numerous denticles. These characters are all eulophid ones, and are, in fact, the diagnostic attributes used to recognize many genera as belonging to the Eulophidae. These characters certainly would refer *Elasmus* to the Eulophidae, and the peculiar shape of the hind coxae may be taken for what it undoubtedly is, an adaptive difference. This leaves no genera for the family Elasmidae. *Elasmus* may, however, be considered to comprise a subfamily Elasminae of the Eulophidae.

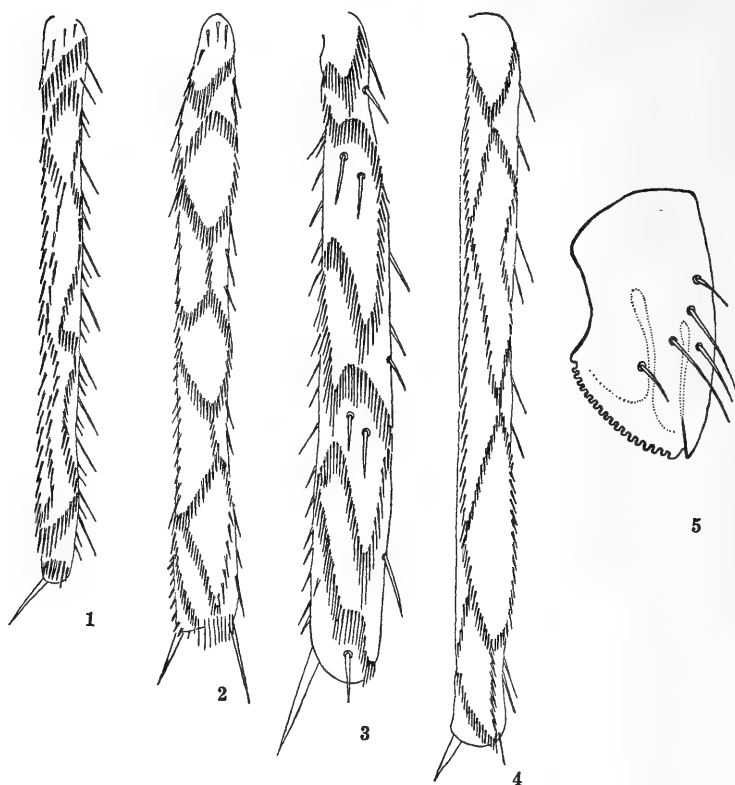
ELASMUS WESTWOOD

KEY TO NEARCTIC SPECIES, FEMALES

1. Scutellum clothed with numerous, closely set, short bristles in addition to 2 pairs of long bristles *setosiscutellatus* Crawford
Scutellum bearing only 2 pairs of bristles 2
2. Bristles on hind tibia arranged in more or less parallel, wavy, longitudinal lines, Fig. 1 3
Bristles on hind tibia arranged to form diamond-shaped or elongate figures, Figs. 2, 3, 4 9
3. Apex of scutellum yellow 4
Scutellum entirely black 5
4. Dorsal half of hind coxa black, ventral half yellow; apex of scutellum with a narrow yellow band *albicoxa* Howard
Hind coxa with a narrow black line on dorsal margin, otherwise yellow; apical half or more of scutellum yellow *mordax* Girault

5. Entire hind coxa yellow *zigzag* Girault
Hind coxa half or entirely black 6
6. Abdomen mostly or entirely black, sometimes slightly lighter at
base *nigripes* Howard
Abdomen marked with bright yellow, at least laterally 7
7. Hind coxa black on basal half, yellow apically *tischeriae* Howard
Hind coxa almost entirely or quite black 8
8. Front coxa entirely white or yellow *borrowi* Girault
Basal third to half of front coxa black, apically white or yellow
..... *marylandicus* Girault
9. Bristles on hind tibia enclosing 7 diamond-shaped areas, 3 on
posterior margin, 4 laterally, Fig. 2 10
Bristles on hind tibia enclosing 5 areas, 2 on posterior margin, 3
laterally, Figs. 3, 4 13
10. Ventral half of head yellow, dorsal half black, with a pair of
minute yellow spots at eye margins opposite lateral ocelli
..... *albizziae*, new species
Head entirely black 11
11. Postscutellum entirely white *apanteli* Gahan
Postscutellum partly or entirely dark brown or black 12
12. Abdomen and hind coxa entirely black, but abdomen may be
slightly lighter at base dorsally *atratus* Howard
Abdomen and hind coxa partly bright tan or yellow
..... *meteori* Ashmead
13. Head yellow except for a small black area around ocelli; posterior
margin of hind tibia with 2 diamond-shaped areas, each of
which contains 2 bristles, Fig. 3 *maculatus* Howard
Head entirely black; enclosed areas on posterior margin of hind
tibia elongate, Fig. 4 14
14. Abdomen bright orange or yellow except for a narrow band at
base, 4 spots on dorsum, and the 2 apical terga, which are
black *floridensis* Girault
Abdomen entirely black, or with 2 faint, transverse yellow or
orange median dorsal bands *pulex* Girault

The specific classification of *Elasmus* at present is based entirely on the females, because characters for the identification of most of the males have not been found. As Ferrière (1947: 568) remarked, "It is useless to try to determine a species of which one knows only the males." *Elasmus varius* Howard, 1885, and *E. pullatus* Howard, 1885, are, thus, unrecognizable, since they were described from the males only, and it has not been possible subsequently to associate females with them. It may be that *pullatus* and *atratus* Howard, 1897, are male and female of the same species. Not even a guess can be made at present about the identity of *varius*.



North American *Elasmus*. FIGS. 1 to 4. Left hind tibia: 1, *albicoxa*; 2, *albizziae*; 3, *maculatus*; 4, *pulex*. FIG. 5, right mandible of *albizziae*.

***Elasmus albizziae*, new species**

Female: Length 2.3–2.5 mm. Ventral half of head and a small spot at eye margin beside each lateral ocellus, antennal scape, sides of pronotum and anterolateral angles of mesonotum, tegulae, areas at lateral and apical margins of scutellum, and postscutellum, yellow; entire foreleg, midleg and hind leg beyond middle of coxa, white (although there is a minute black line on dorsal margin of mid and hind femora); abdomen mostly orange-tan or red-brown; dorsal half of head, antennal pedicel and flagellum, dorsal part of pronotum, mesonotum (except for anterior angles), meso- and metathoracic pleura, dorsal half of each hind coxa, base and variable areas on terga of abdomen, and apex of ovipositor sheaths, black. Wings hyaline, veins white. Head, body, and appendages clothed with dark brown or black setae and bristles.

Head slightly broader than high; frons with scattered umbilicate punctation, interstices faintly reticulated, almost smooth. Mandibles symmetrical, each with one small ventral denticle and a row of 17–19 minute dorsal denticles, Fig. 5. Ocellocular line as long as diameter of lateral ocellus. Relative lengths of parts of antenna: scape, 35; pedicel, 12; first funicular, 12; second, 13; third, 15; club, 30.

Bristle at posterolateral angle of pronotum as long as lateral margin of pronotum; 10 long bristles in median area of posterior margin of praescutum; tegula bearing 8 bristles; humeral plate of forewing with one long bristle. Forewing with submarginal vein $\frac{1}{3}$ as long as marginal, postmarginal and stigmal each $\frac{1}{12}$ as long as marginal. Four bristles at apex of fore coxa, 2 long and one shorter bristles at apex of mid coxa, and hind coxa with 3 anterior and one lateral apical bristles. Row of bristles along posterior margin of mid tibia straight (not sinuate near base, as in *maculatus*); mid femur with disc lacking bristles, these present only in dorsoapical area, and inner apical bristle short. Hind femur with apical bristles; hind tibia with 7 diamond-shaped areas, Fig. 2. Scutellum smooth and shining, bare except for 2 pairs of equally long, lateral bristles; postscutellum projecting only to middle of propodeum (not nearly reaching its posterior margin, as in *maculatus*).

Propodeal spiracle small, round, touching anterior propodeal margin. Abdomen slightly longer than head, thorax, and propodeum combined; first tergum twice as long as second; fifth tergum with a transverse, irregular row of bristles, sixth tergum with 3 transverse rows of shorter bristles, seventh tergum densely bristled. Apex of ovipositor sheaths slightly projecting beyond apex of abdomen.

Male: Unknown.

Holotype: USNM no. 67800.

Described from 12 ♀♀, all reared from *Homadaula albizziae* Clarke: Holotype, Marion Co., Ohio, 26 August 1964, J. W. Peacock; 9 paratypes, Champaign, Illinois, 2 August 1962, C. Scherer; 2 paratypes, Camden Co., New Jersey, 13 September 1960, L. G. Merrill. All specimens in USNM collection.

This species resembles *zehntneri* Ferrière, from India, Indonesia, and the Philippines, in having the funicular segments longer than wide, 7 diamond-shaped areas on the hind tibia, the entire foreleg white, the middle leg white with a narrow, black line on the dorsal margin of the femur, the hind leg white with the dorsal half of the coxa and the dorsal margin of the femur black, the mesoscutum black, the postscutellum white, and the abdomen mostly tan or red-brown. The two differ in that *albizziae* has the ventral half of the head yellow, rather than black, and the scutellum has the lateral and apical margins yellow, rather than black. *E. maculatus*, from Florida, the West Indies, and Brazil, has a color pattern somewhat like that of *albizziae*, but it has only 5 diamond-shaped areas on the hind tibia. Other differences between *albizziae* and *maculatus* are pointed out in the preceding description.

Elasmus albizziae may be one that has recently been introduced into the United States, possibly from the Oriental region. Although *Homadula albizziae* Clarke has been a common pest on the leguminous tree *Albizzia julibrissin* (and to a lesser extent on related trees) since 1940, this *Elasmus* parasite was first found attacking it in September of 1960, in Camden Co., New Jersey. This parasite, to judge from the material of it I have received for identification since 1960, has subsequently spread westward to Illinois and southward as far as Maryland. Reared specimens have always come only from *Homadula albizziae*.

This *Elasmus* is quite unlike any other North American species of the genus, but it resembles some of the described Oriental ones in color and structure. Its general habitus certainly suggests an Oriental *Elasmus*, but I have not been able to place it as a described Oriental species, or for that matter, as a described species from any other region of the world. Since a name is now needed for it here, I have described it.

SYNONYMY

Elasmus albicoxa Howard, 1885, U. S. Dep. Agr., Bur. Entomol. Bull. 5: 30. "♂" ♀.

Elasmus aspidiscae Girault, 1917, Insecu. Insci. Mens. 4: 117. ♀. New synonymy.

Howard described *E. albicoxa* from a broken specimen that lacked the abdomen and evidently also the antennae. He took it to be a male, but female specimens that agree with it have been taken subsequently. The male specimens that are associated with these females are quite different in color, being almost completely black, but they have the bristles on the hind tibia arranged in the same distinctive pattern as do the females.

E. aspidiscae, represented in the USNM collection by a single broken female, differs in no detectable way from *albicoxa*. Girault (1918: 2) said that his *aspidiscae* probably was the same as *albicoxa*.

Elasmus nigripes Howard, 1885, U. S. Dep. Agr., Bur. Entomol. Bull. 5: 30. ♂.

Elasmus missouriensis Girault, 1917, Insecu. Insci. Mens., 4: 117. ♀. New synonymy.

E. nigripes was originally described from a male, but subsequently it has been possible to find female specimens that were associated with males that are identical with the type of *nigripes*. *E. missouriensis* was described from a single female specimen that agrees in all particulars with the females that have been associated with the male of *nigripes*.

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PROCEEDINGS
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XILITLONISCUS, A NEW GENUS FOR THE MEXICAN
TROGLOBITIC ISOPOD, *CORDIONISCUS LAEVIS*
RIOJA (ONISCOIDEA: TRICHONISCIDAE)

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In 1956 the late Enrique Rioja described a new species of trichoniscid isopod, *Cordioniscus laevis*, from Cueva de la Hoya, near Xilitla, San Luis Potosi, Mexico. Previously only two species of *Cordioniscus* had been known: *C. stebbingi* (Patience), occurring in greenhouses in Europe and the United States, but apparently native to eastern Spain (Vandel, 1952); and *C. africanus* Vandel (1955) from Oran, Algeria. *Cordioniscus laevis* was thus the first native American species of *Cordioniscus* and the most northern Western Hemisphere member of Vandel's superfamily Styloniscoidea, predominately a Southern Hemisphere group not known previously north of Costa Rica (Vandel, 1952).

Unfortunately Rioja had only a single female of his new species, and his decision to place it in *Cordioniscus* was based on the short third segment of antenna 1, the armature of the inner ramus of maxilla 1, and the number of mandibular setae. He was unable to use the structure of the male pleopods 1 and 2, which are more fundamental characters.

I received recently from James Reddell, of the Texas Speleological Survey, male and female isopods from two caves near Xilitla that appear to belong to Rioja's *Cordioniscus laevis*. However, from the structure of the male pleopods 1 and 2, Rioja's species clearly belongs in the superfamily Trichoniscoidea rather than Styloniscoidea and in Vandel's first, and most primitive, division of the family Trichoniscidae. Because it cannot be placed in any existing genus, I am proposing for it the following new genus:

Xilitloniscus, new genus

In general aspect and in most characters like *Protrichoniscus* Arcangeli (1932), but differing as follows: Antenna 1, 2d segment nearly as long as 3rd. Right mandible with 1 seta between incisor and molar and 1 seta on molar. Left mandible with 2-3 setae between incisor and molar and 1 seta on molar. Pereopod 7, distal setae of setal fringe along posterior margin of propodus not clearly forming a tuft. Male pleopod 1 without endopod; exopod with plumose terminal seta. Exopod of male pleopod 2 separated from basis by suture. Type-species, *Cordioniscus laevis* Rioja. Gender masculine.

Xilitloniscus laevis (Rioja)

Figs. 1-30

Cordioniscus laevis Rioja, 1956: 447-451, Figs. 1-13; Mulaik, 1960: 98-99, Figs. 513-526 [copy of Rioja's description and illustrations].

Material examined: MEXICO, SAN LUIS POTOSI STATE: Cueva de la Selva, 8 km W of Xilitla, in pools: 26 November 1963, 2 ♀♀, collected by Terry Raines; 25 November 1964, 4 ♀♀, 2 ♂♂, collected by Terry Raines and Bill Bell. Cueva de la Porra, 10.9 km NE of Xilitla, in small pool 37 m from entrance, 3 ♀♀, 1 ♂, collected by Bill Russell.

Description: Length up to 12 mm. Pereonites without tubercles on dorsal posterior margins. Telson with 2 minute apical setae. Penis gradually tapering to narrow apex bearing slender seta. Distal segment of antenna 1 with 11 slender sensory filaments. Antenna 2 reaching posterior margin of pereonite 3; flagellum 8-merous.

Incisor of left mandible with 4 teeth, lacinia mobilis with 3 teeth; 2 plumose setae between incisor and molar; molar with 1 seta. Incisor of right mandible with 3 teeth, lacina a narrow cylinder with distal margin divided into about 9 teeth; 1 plumose seta between incisor and molar and 1 on molar.

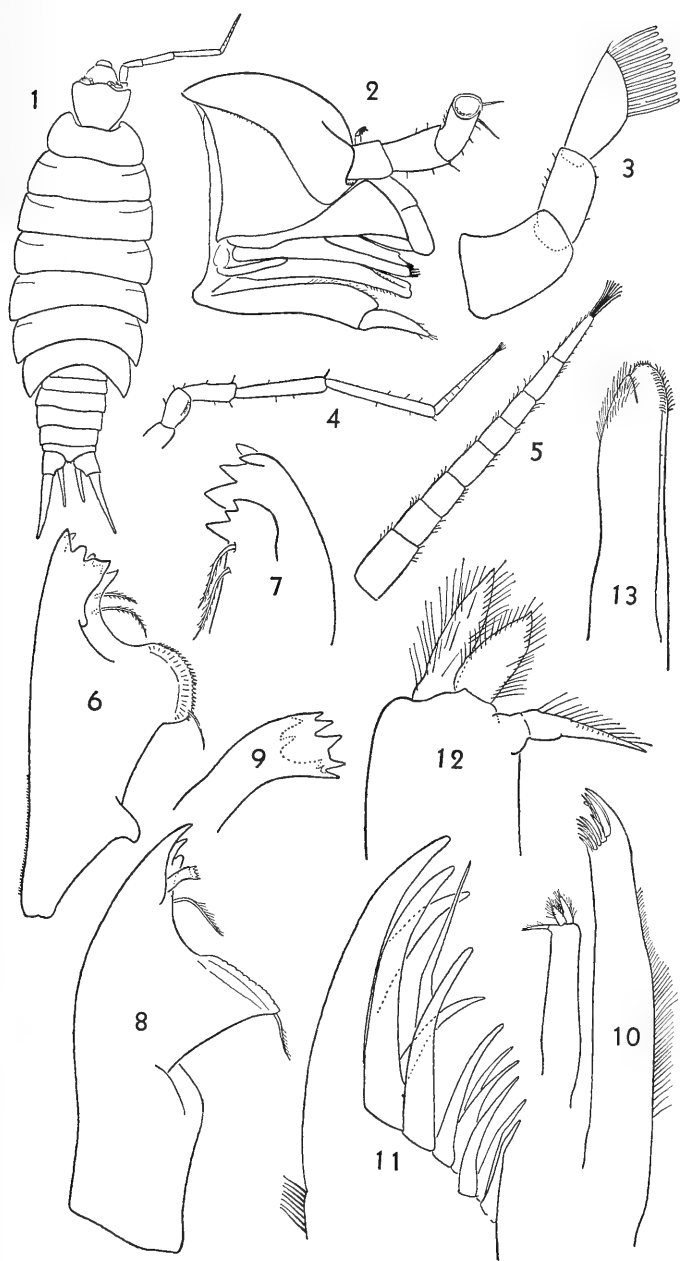
Inner ramus of maxilla 1 armed at apex with 2 blunt terminal setae, the lateral one slightly longer, and a slender medial seta subequal to longer blunt seta. Outer ramus with 6 large lateral and 6 small medial spines; 1 of large spines slender, with angular bend in middle.

Endite of maxilliped with long robust terminal spine, flanked by 2 short blunt spines and medially with a slender arcuate spine.

Posterior margin of carpus of pereopods 1-2 bearing strong spines

→

FIGS. 1-13. *Xilitloniscus laevis* (Rioja). Fig. 1, dorsal view. Fig. 2, head, lateral. Fig. 3, antenna 1. Fig. 4, antenna 2. Fig. 5, antenna 2, flagellum. Fig. 6, left mandible. Fig. 7, incisor of left mandible. Fig. 8, right mandible. Fig. 9, lacinia mobilis of right mandible. Fig. 10, maxilla 1. Fig. 11, outer ramus of maxilla 1. Fig. 12, inner ramus of maxilla 1. Fig. 13, maxilla 2.



with apical prongs; propodus with similar but shorter spines. Medial surface of carpus and propodus with delicate overlapping triangular scales, visible only with high magnification; with low magnification bases of scales give crosshatched appearance to scaled areas.

Propodus of pereopod 7 with fringe of setae along distal $\frac{3}{4}$ of posterior margin; distal setae longer but not forming a tuft so clearly as in *Protrichoniscus*. Pereopod 6 shorter than pereopod 7, with shorter setae on posterior margin of propodus.

Endopod apparently absent from male pleopod 1. Basis rotund laterally, slenderer medially. Exopod oblong in proximal $\frac{4}{7}$, triangular in distal $\frac{3}{7}$; narrow apex bearing long plumose seta; medial margins closely apposed, forming groove to receive penis.

Exopod of male pleopod 2 separated from basis by suture, oval, with lobe extending over base of endopod. Endopod well developed; distal segment with blunt tip hollowed on one side.

Exopods of pleopods 3-5 broadly subtriangular, membranous. Endopods narrow, pustulate.

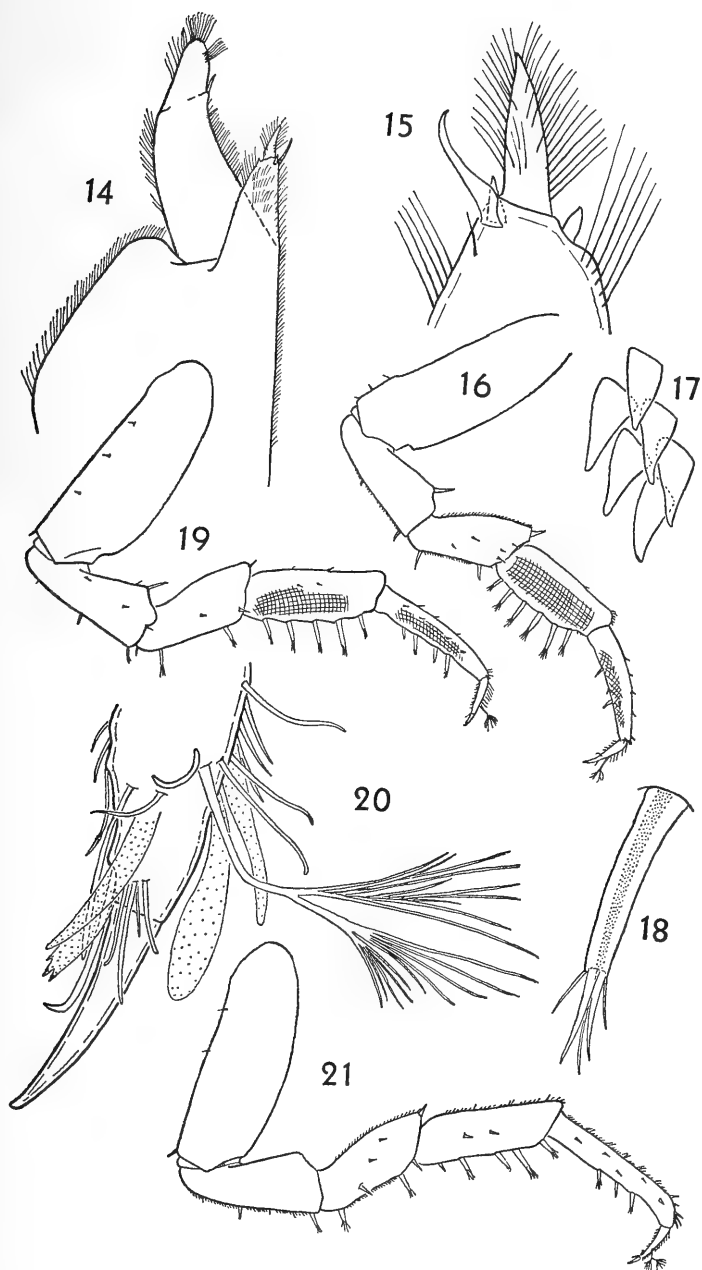
Uropods with narrow rami; exopod 1.5 times as long as endopod, both ending in tufts of setae.

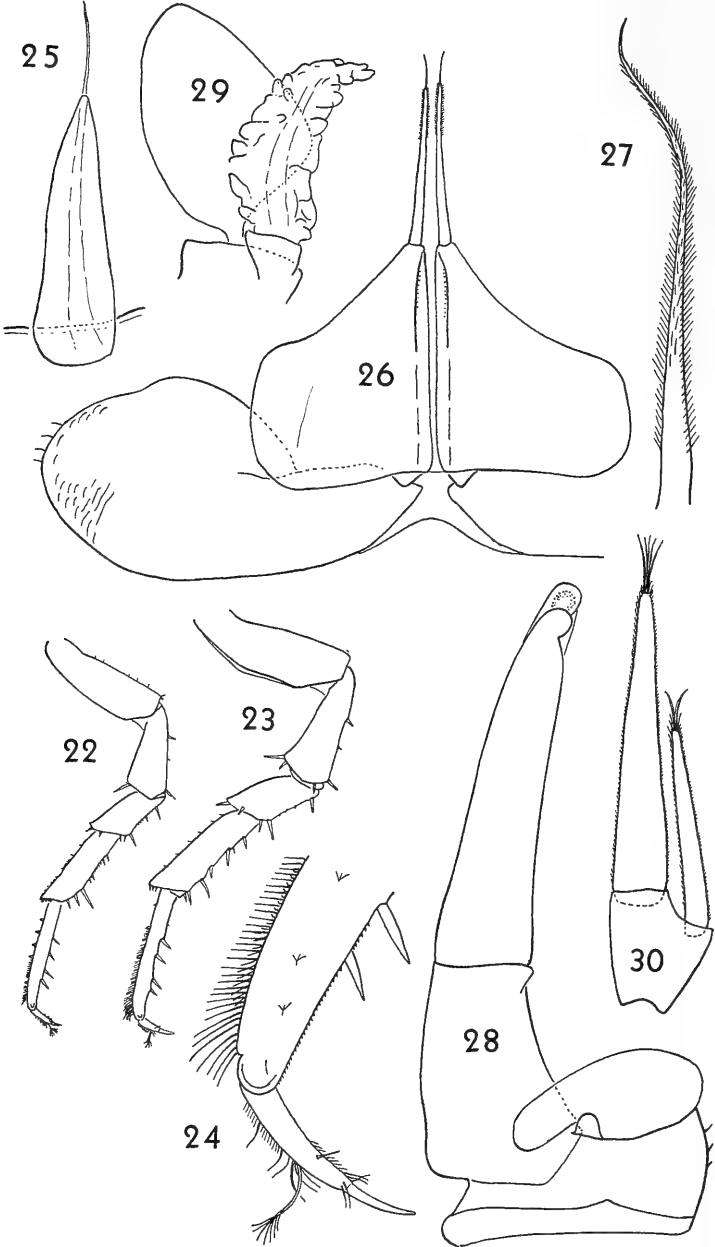
Relationships: *Xilitloniscus* is most closely related to *Protrichoniscus*, the only other genus of the family Trichoniscidae in which the endopod of male pleopod 1 is greatly reduced or absent. The terminal seta on the exopod of male pleopod 1 is not present in *Protrichoniscus*, as far as is known. Unfortunately the male pleopods were not described in Mulaik's (1960) two species, *P. palmitensis* and *P. potosinus*. Of the six known species of *Protrichoniscus*, five are known only from Mexican caves, and the type-species, *P. heroldi* Arcangeli (1932), occurs in California (Mulaik and Mulaik, 1942, 1943).

Rioja (1955) reviewed the 3 Mexican species then known and provided a key to the 4 known species. More recently Mulaik (1960) reviewed the Mexican species, adding 2 new species, and gave a key to the Mexican species. Mulaik removed *Protrichoniscus* from the family Trichoniscidae and placed it in the Styloniscidae, because of the molar seta in the right mandible of *Protrichoniscus*. This action ignores the fundamental difference in the form and musculature of male pleopod 1, which led Vandel (1952) to establish the superfamilies Styloniscoidea and Trichoniscoidea. Vandel (1953) examined specimens of *Protrichoniscus heroldi* and found the male pleopod 1 to be of the "type trichoniscien" rather than the "type styloniscien." He placed *Protrichoniscus* in

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FIGS. 14-21. *Xilitloniscus laevis* (Rioja). Fig. 14, maxilliped. Fig. 15, endite of maxilliped. Fig. 16, pereopod 1, medial view. Fig. 17, scales on propodus of pereopod 1. Fig. 18, spine on carpus of pereopod 1. Fig. 19, pereopod 2, medial view. Fig. 20, distal end of dactyl of pereopod 2. Fig. 21, pereopod 3, medial view.





the first, or most primitive tribe (called "Division" in 1960) of the subfamily Trichoniscinae. To the genera belonging to this Division we must now add *Xilitloniscus*.

Ecology: *Xilitloniscus laevis* is a blind troglobite now known from three caves in the vicinity of Xilitla. Rioja's specimen was collected from the cave wall, while the specimens sent to me were found in small pools inside the caves.

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FIGS. 22-30. *Xilitloniscus laevis* (Rioja). Fig. 22, pereopod 6. Fig. 23, pereopod 7. Fig. 24, distal end of pereopod 7. Fig. 25, penis. Fig. 26, ♂ pleopod 1. Fig. 27, terminal seta of exopod of ♂ pleopod 1. Fig. 28, ♂ pleopod 2. Fig. 29, pleopod 5. Fig. 30, uropod.

PROCEEDINGS
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NEW BRACKISH WATER MOLLUSKS FROM LOUISIANA

BY JOSEPH P. E. MORRISON¹
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In the course of continuing research on the brackish water mollusks of southeastern United States, the following forms were found to be new. The unstinted cooperation of the late Percy Viosca, Jr., as well as that of his assistants and superiors of the Louisiana Wild Life and Fisheries Commission has materially increased our knowledge of the fauna living in the waters of the Mississippi Delta region.

GASTROPODA

Family HYDROBIIDAE Troschel, 1857

Subfamily Hydrobiinae, s. s. Morrison (emend.) 1949

Vioscalba, new genus

Shell subcylindric or pupiform; apex obtuse; constricted aperture evenly elliptic inside thickened lip. Operculum corneous, paucispiral. Animal with male organ large, originating dorsally, traversed only by vas deferens, and ornamented with only one rounded lobe on left (anterior) side.

Type-species: Vioscalba louisianae, new species.

At first sight these shells recall the Asiatic genus *Stenothyra*, which belongs to the family Rissoiidae. They differ from *Stenothyra* by possessing a conspicuous varix behind the lip, which projects laterally, increasing the shell diameter. Although shells of *Vioscalba* are markedly similar to (but smaller and more slender than) those of known species of *Notogillia*, the relatively simple male organs of *Vioscalba* will distinguish this new genus.

Vioscalba louisianae, new species
(Figs. 1, 2)

Shell small, elongate-ovate, polished, translucent, of $4\frac{1}{2}$ slightly convex whorls, separated by distinct but very shallow suture, microscopically spirally striate, and with minute growth lines. Spire narrowly obtuse, first 3 whorls rapidly increasing, last whorl deflected, increasing rapidly only in height, almost three-fourths shell height, and abruptly constricted

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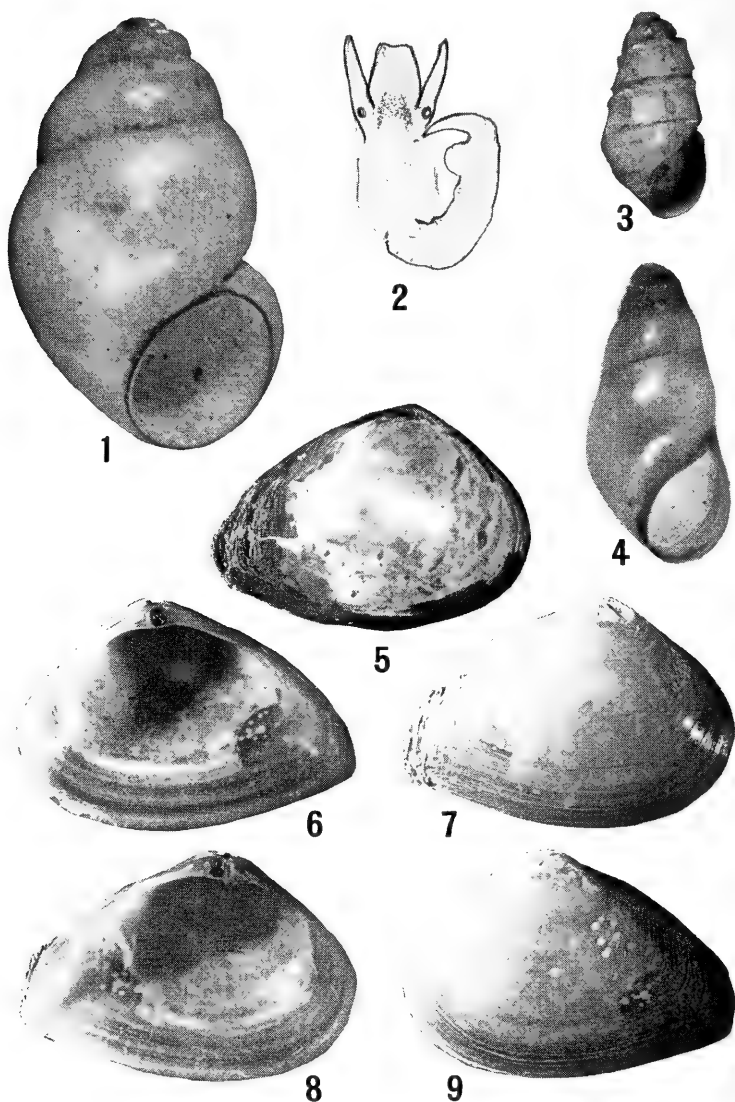


FIG. 1. *Vioscalba louisianae* Morrison, holotype USNM no. 635627, from off Frenier Beach, Lake Pontchartrain, Louisiana.

FIG. 2. *Vioscalba louisianae* Morrison, sketch of head and male organ of paratype, USNM no. 635629, from off Goose Point, Lake Pontchartrain, Louisiana.

at aperture. Entire shell thus appears somewhat subcylindrical or pupiform. Abrupt (downward) constriction of last whorl at aperture causes heavy variciform thickening of lip to appear to fill upper angle of whorl, producing in mature shells an almost evenly elliptic peritreme, not angled above. Aperture entire, somewhat oblique; umbilicus a very narrow but distinct slit, continued upward above very briefly solute lip.

Operculum thin, corneous, paucispiral, of about $2\frac{1}{2}$ turns.

Animal of normal hydrobiine type, with snout and tentacles of moderate length. Prominent eyes in outer bases of tentacles. Male organ large, situated well back dorsally, and relatively simple. Only one rounded lobe on left (anterior) side of distal half. Distal third (functional tip) of verge regularly tapered to point. Pigmentation of entire animal, especially of verge, very light. In life, animal nearly all milk-white in appearance. Only evident pigment is greyish area on snout and head, between eyes.

The holotype, USNM no. 635627, was dredged from sandy mud bottom off Frenier Beach, in the southwestern part of Lake Pontchartrain on 5 November 1959 by the late Percy Viosca, Jr., and the writer. It measures: height 3.3 mm; diameter 2.2 mm; aperture height 1.2 mm; aperture diameter 1.1 mm. An estimated thousand paratypes, USNM no. 635628, from the same dredging sample range in size from 2.7 to 3.6 mm in height, and from 1.7 to 2.4 mm in diameter. As is usual in many species of the Hydrobiinae, the males are apparently of smaller average size. Approximately another thousand specimens are included in more than twenty-five additional paratype lots in the U. S. National Museum collection, collected by Viosca and by the writer. The numerous specimens seen to date have amply proven this species distinct from all others.

Shells of this species were found in the crops of ducks a half century before they were discovered living in Lakes Pontchartrain and Borgne by Mr. Viosca. They occur in countless numbers in those lakes. Dead shells dredged from the east side of the Mississippi delta south of Hope-dale, Louisiana, and in Heron Bay, Mississippi, indicate that this snail lives in those localities also.

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FIG. 3. *Odostomia weberi* Morrison, holotype, USNM no. 635638, from bay north of Bayou Chene Fleur, Barataria Bay, Louisiana.

FIG. 4. *Odostomia barretti* Morrison, holotype, USNM no. 635630, from Heron Bay, Mississippi.

FIG. 5. *Mulinia pontchartrainensis* Morrison, older, eroded paratype, USNM no. 635645, from off Frenier Beach, Lake Pontchartrain, Louisiana.

FIGS. 6-9. *Mulinia pontchartrainensis* Morrison, holotype, USNM no. 635643, from Middle Ground, Lake Pontchartrain, Louisiana.

The present species is very close to, but is not identical to the one described by Pilsbry as *Probythinella protera* from the Pliocene of Tampa Bay, Florida (1953 Acad. Nat. Sci. Phila., Monogr. 8; 444, Pl. 64, Fig. 6). This second species of *Vioscalba*, *V. protera*, has a more abruptly truncated spire. The body whorl and the penultimate whorl of *protera* are flatter toward the suture; in contrast, all whorls of *louisianae* are more regularly rounded from suture to suture. The shells of *louisianae* appear markedly more obese than the specimens of *protera* seen.

Family PYRAMIDELLIDAE

Genus *Odostomia* Fleming, 1813

***Odostomia barretti*, new species**

(Fig. 4)

Shell minute, slender, imperforate, ovate-conic, vitreous, of about $5\frac{1}{2}$ whorls. Flat-sided whorls separated by linear almost unimpressed suture. Apex subtruncate; nuclear whorl rounded, with dividing suture moderately incised. After first two whorls, suture impression disappears, with extreme flattening of whorls. Sculpture smooth, glossy, with minute growth striae only that slant forward at suture. Aperture generally oval; columellar and parietal walls at a slight angle to each other, posterior angle distinctly narrowed. Lip very slightly thickened within, but in no way reflected.

Operculum corneous, paucispiral.

The animal has not been examined; this species is allocated to *Odostomia* on the basis of shell characters.

The holotype, USNM no. 635630, measures: height 2.1 mm, diameter 1.0 mm, aperture height 0.8 mm, aperture diameter 0.5 mm. It and 24 paratypes, USNM no. 635631, were dredged from algae-covered mud bottom in about 4 ft of water in the northeast corner of Heron Bay, Mississippi. Additional paratypes, USNM no. 635632, were dredged from mud bottom in 8 ft of water near the mouth of Heron Bay. The species has been found off Bayou Thomas, in Lake Borgne, USNM no. 635633, and from three stations in the eastern part of Lake Pontchartrain, USNM no. 635634, 635635, and 635636. It is also living in Oyster Bay, south of Hopedale, Louisiana, USNM no. 635637.

This minute species is named for Ronny Barrett, former research assistant to Viosca. These snails were discovered living in the company of *Texadina sphinctostoma*. They are easily differentiated from the *Texadina* shells because they are more slender, glassy smooth, with extremely flat-sided whorls, and usually much smaller. A few larger shells of this species resemble in a general way *Odostomia caloosaensis* Dall, but they are thinner. The tiny translucent species *barretti* is smaller than any other Louisiana member of the group known to me except the following, in which the adult is even more minute.

Odostomia weberi, new species

(Fig. 3)

Shell minute, imperforate, cylindro-conic, vitreous-white, with about three whorls remaining. Apex and early whorls eroded, not seen in any immature and adult shells at hand. Whorls pinched into a keel at periphery; peripheral keel, most prominent on early whorls, may be partially obsolete just behind aperture. A second strong keel a little below suture. In between, posterior or spire slope of whorls flat, ornamented only by micro-spiral striations and microscopic growth lines. Suture strikingly like a plowed furrow with narrow but distinct raised ridges bounding open furrow of even width and depth between all remaining whorls. Aperture regularly ovate, angled posteriorly; columellar wall thickened internally, but peristome not reflected in any way.

Operculum thin, corneous, paucispiral, of about 2 rapidly increasing turns.

The animal of this minute species has not been examined. Allocation of the species to *Odostomia* is made on the basis of shell characters.

The holotype, USNM no. 635638, was dredged from muddy bottom in about 4 ft of water in the small bay north of Bayou Chene Fleur, northern part of Barataria Bay, Louisiana, 10 November 1959. The holotype has 3 whorls remaining and measures: height 1.4 mm; diameter 0.7 mm; aperture height 0.5 mm; aperture diameter 0.3 mm. Twenty five paratypes, USNM no. 635639, are from the same source. The maximum size of the paratypes is about 1.7 mm in length and 0.8 mm in diameter. Twenty two additional paratypes, USNM no. 635640, were dredged from mud and shell bottom, off Hamilton's Oyster Camp, in Bayou Chene Fleur. One specimen, USNM no. 635641, was dredged in Sugar House Bend; one live one, and an empty shell were dredged from the mud and plant debris on the bottom of the Grand Terre Canal, proving it also lives on the south side of Barataria Bay. Its presence on the east side of the Mississippi delta is indicated by the finding of shells, USNM no. 635642, in Oyster Bay, south of Hopedale.

The small size of these minute adult snails may partly explain why they have not been seen before. They were actually discovered in the residue of the dredge washings. They are so small that almost all of them are washed through a 20 mesh-to-the-inch, monel wire screen. The true abundance or even the presence of this species in a locality must be checked in the field by the use of screens of even finer mesh.

These tiny shells resemble the uppermost three whorls of such forms as *Orinella locklini*, but with the suture bordered above and below by strong keels, instead of the simple wide suture of that Tampa Bay, Florida, species. *Odostomia weberi* is named in honor of the late Jay A. Weber of Miami, Florida, who first stimulated my interest in Louisiana mollusks more than a decade ago.

PELECYPODA
 Family MACTRIDAE
 Genus *Mulinia* Gray, 1837

Mulinia pontchartrainensis, new species

(Figs. 5-9)

Shell small, markedly trigonal, equivalve, compressed; umbones low, persistently adjacent, smooth; posterior ridge low, somewhat biangulate, ending at postbasal point. Shell porcelaneous, externally chalky when eroded, with a thin epidermis most evident on posterior ridge; anterior end rounded, slightly shorter than produced or rostrate posterior end. Hinge with inverted V-shaped cardinal tooth in left valve over which fit the two divergent lamellar cardinals of right valve; accessory lamella is present in left valve, forming anterior edge of cartilage pit; single anterior and posterior lateral teeth in left valve lock between paired less prominent anterior and posterior laterals of right valve. Laterals smooth and short, not quite reaching anterior and posterior adductor muscle scars. Adductor scars distinct, anterior smaller; pallial sinus inconspicuous, wide and very shallow. Hinge ligament and cartilage completely enclosed; internally finely granulate margin of shell continuous dorsally over pit. Ligament small, inserted on posterodorsal surface of pit; cartilage larger, inserted on ventral surface of pit, persistent, with lateral ends usually projecting externally from eroded umbones.

The holotype, USNM no. 635643, and approximately a thousand paratypes, USNM no. 635644, were dredged from the "Middle Ground" in the eastern part of Lake Pontchartrain, Louisiana, on 5 November 1959. The holotype measures: length 9.2 mm, height 6.3 mm, diameter 4.1 mm. A series of selected paratypes from this sample measure:

| Length | Height | Diameter |
|--------|--------|----------|
| 9.0 mm | 6.4 mm | 4.0 mm |
| 8.8 | 6.3 | 3.7 |
| 7.9 | 6.5 | 3.4 |
| 8.0 | 5.9 | 3.0 |
| 6.9 | 4.6 | 2.7 |
| 5.9 | 4.2 | 2.3 |
| 5.5 | 4.1 | 2.4 |
| 4.9 | 3.6 | 2.0 |
| 4.4 | 3.6 | 1.8 |

At the present time this species is known from Lakes Pontchartrain and Borgne, southward to below Pointe a la Hache and in the northern waters of Barataria Bay, Louisiana. In Mississippi it is recorded from Heron, St. Louis, and Back bays, and from Davis Bayou, east of Ocean Springs.

It has been dredged once from Mobile Bay. The extent of its occurrence and the degree of its abundance there is still in need of examination.

The shells of *pontchartrainensis* appear more compressed and trigonal

in outline than the ovate juveniles of *Rangia cuneata* (Gray) in whose company they may be living. The ten specimens listed have an average length of 7.05 mm, with the height at 73.05% and the diameter at 41.7% of the length. Ten specimens of *Rangia cuneata* (juveniles of comparable size range) average 6.72 mm in length, with the height at 75.4% and the diameter at 48.11% of the length. There is too much individual variation for the mathematical separation by percent of diameter to be completely successful. Even in the smallest juveniles seen, the beaks of *cuneata* are markedly separate, in direct contrast to the adjacent beaks of *pontchartrainensis*.

This new species is usually more compressed, more trigonal, and always has a much heavier hinge plate than *Mulinia lateralis* (Say). The heavier, more compressed shells have much shallower beak cavities and lack the conspicuous pallial sinus that extends at least one-third of the ventral distance between the adductor muscle scars on the shells of *lateralis*. They are more compressed and trigonal in outline, with a shallower pallial sinus than *Mulinia harrisi* Smith from the Pliocene of Louisiana. They differ from *Mulinia sapotilla* Dall of the Caloosahatchie Pliocene by being smaller, thinner, and less rostrate posteriorly.

Long suspicious of the "juvenile *Rangia*" he knew were present in untold numbers in the Lake Pontchartrain bottoms, it remained for Percy Viosca to furnish the final proof that this is a distinct and separate species. His examination of living clams collected in November proved them to be sexually mature, prepared to reproduce the following spring (if that be the breeding season). Later observations and analyses of more than 30,000 paratypes included in approximately 80 lots now in the United States National Museum have effectively demonstrated that this species matures after one year's growth. These 10 mm adults may show old age characters (marked erosion of the shell) even though they are smaller than one-year-old juveniles of *Rangia cuneata*.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DESCRIPTIONS OF THREE NEW SPECIES OF
BRACHORIA, WITH NOTES ON ESTABLISHED SPECIES
(DIPLOPODA, POLYDESMIDA, XYSTODESMIDAE)

BY WILLIAM T. KEETON¹
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In 1959, I published a revision of the genus *Brachoria*. At that time I recognized 25 species in the genus (plus two additional subspecies), many of them known only from the type locality. Since then, numerous additional specimens have become available for study; these specimens make possible the description of three new species, several range extensions, treatment of geographic variation within some of the species, and critical evaluation of several species and subspecies.

Most of the specimens upon which this study is based were generously loaned to me by Dr. Richard L. Hoffman, to whom my sincere thanks are extended. I am also indebted to Dr. Ralph E. Crabill, Jr. for permission to study the type specimen of *Fontaria evides* Bollman in the United States National Museum and to Mrs. Doris Ash, who aided in the preparation of some of the drawings.

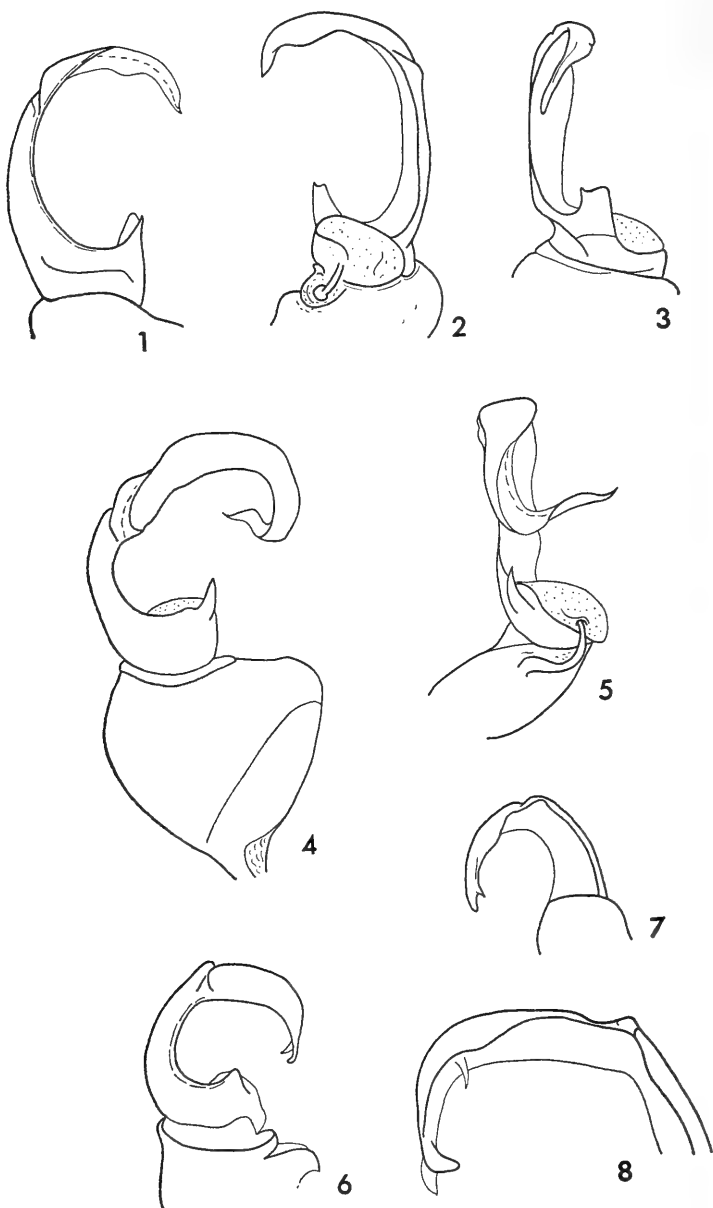
***Brachoria conta*, new species**
(Figs. 1-3)

Diagnosis: Distinguished from all other species of the genus by the form of the postcingular portion of the telopodite of the gonopod, which appears very thin when viewed medially and which, in cephalic or caudal views, is characteristically much the widest dorsoventrally at a point roughly midway between the cingulum and the apex. Does not closely resemble any other species in the genus.

Description: Length of male holotype, 43.4 mm; greatest width, 10.0 mm; L/W ratio, 4.3.

Collum subellipsoid, the posterior edges of its paranota angled slightly forward at their bases, ends of paranota rounded. Faint marginal ridges along cephalic margins of paranota, but becoming obscure on the ends of the paranota.

¹ Research supported by Grant GB-701 from the National Science Foundation.



Peritremata present but much reduced on segments 2 and 3, more obvious on other segments but never prominent. Posterolateral corners of paranota rounded forward on segments 2-4, slightly angled on 5, subrectangular on 6, and produced slightly caudad on 7, becoming more strongly produced caudad on all succeeding segments.

Sternum of 3rd legs with the usual pair of contiguous medial processes; sternum of 4th legs with pair of prominent processes, narrowly separated from each other; slight elevations at bases of 5th legs, but none at bases of 6th and 7th, the sterna being shallowly concave and polished. Podosterna of postgenital legs normal, the portion between 2nd pair of legs of each segment depressed medially, forming obscure subcoxal processes on the most posterior segments.

Coxal spines absent from first 6 leg pairs, represented by a small knob on legs 7 and 8; small but definite spines on 7th legs, becoming progressively longer to segment 15, then becoming somewhat reduced on more posterior segments. Trochanteral spines prominent.

Male gonopods of medium size (telopodite arc length about 2.13 mm). Telopodite curved mesad at the cingulum, then mesodorsad distally; distal half of postcingular portion compressed anteroposteriorly; inner edge of postcingular arc irregularly curved, producing a pronounced lobe on inner margin at point approximately midway between cingulum and distal end, the postcingular consequently much the widest dorsoventrally at this point; distal end of telopodite tapering, the apex acute, no distinct solenomerite; precingular portion slightly longer than postcingular portion. Basal spine broad and heavy, its end concave, the cephalic corner acute.

Color pattern trimaculate; collection label says, "in life paranotal spots creamy yellow, median spots flesh or salmon." Note from Hoffman says, "Dark brown, paranota dull yellow, including entire lateral fourth of collum, and epiproct. A median row of big tan spots, smallest on segment 2, largest on 15 where almost touching paranotal spots; collum with large anterior median spot and small posterior one. Venter yellowish white, legs becoming yellow distally."

Type specimen: Male holotype from 5 miles W of Grayson, Carter County, Kentucky, 22 April 1961, R. W. and V. G. Barker. USNM.

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FIGS. 1-3. *Brachoria conta*, left gonopod: 1, cephalic; 2, caudal; and 3, cephalomesal views. FIGS. 4-5. *Brachoria enodicuma*, left gonopod: 4, cephalic; and 5, mesal views. FIGS. 6-8. *Brachoria divicuma*, left gonopod: 6, cephalic view; 7, ventrocaudomesal view; 8, caudal view showing detail of distal end of telopodite (the spine just beyond the midpoint of the postcingular portion was present in this specimen only).

***Brachoria enodicuma*, new species**
(Figs. 4-5)

Diagnosis: Clearly related to *separanda* (Causey), *eutypa* Chamberlin, *plecta* Keeton, *hamata* Keeton, and *versicolor* Hoffman. Distinguished from the latter two by the absence of an abruptly hooked or recurved solenomerite and from *plecta* in that the portion of the telopodite just distal to the cingulum is not so noticeably thickened and does not contrast so strongly with the distal half of the postcingular portion; also distinguished from *plecta* in the shape of the telopodite. Difficult to distinguish from the very variable species *eutypa*, from which it differs in the slightly more robust postcingular telopodite, in the more extreme caudal curvature of the telopodite, and in the form of the distal end of the gonopod, which in *eutypa* is always reduced and hooklike but with the apex blunt, while in *enodicuma* it is reduced but not so hooklike and with the apex acute. Probably closely related to *separanda*, from which it is distinguished by details of the shape and curvature of the postcingular portion of the telopodite.

Description: Length of males, 38.3-39.3 mm (holotype 38.3); width, 10.5-11.0 mm (holotype 11.0); L/W ratio, 3.5-3.7 (holotype 3.5). Length of female, 36.0; width, 9.6; L/W ratio, 3.8.

Collum subellipsoid, posterior edges of paranota angled slightly forward at their bases, ends of paranota rounded but with a slight angulation forming posterolateral corner. Anterior marginal ridges moderately prominent.

Peritremata present but much reduced on segments 2-4, more obvious on other segments but never prominent. Posterolateral corners of paranota rounded on segments 2 and 3 but with hint of an angle, forming nearly a right angle on 4 and 5, produced slightly caudad on 6 and 7, becoming more strongly produced caudad on all succeeding segments.

Sternum of 3rd legs with pair of contiguous median processes; sterna of 4th and 5th legs divided by longitudinal furrows; sternum of 4th with pair of small paramedian processes, that of 5th with small mounds at bases of legs; no processes on sterna of 6th and 7th legs. Podosterna of postgenital segments relatively flat, with little, if any, evidence of subcoxal processes, even in the most posterior segments.

Coxal spines absent from pregenital legs, obscure on 8th and 9th legs, present but small on 10th and all succeeding legs. Trochanteral spines prominent.

Male gonopods of intermediate size (telopodite arc length of type about 1.97 mm). Telopodite curving mesoventrad from near its base, then mesad, then dorsad, then caudad from approximately the midpoint of postcingular portion; distal end narrowed, the apex sharp but not particularly hooklike. Basal spine moderately long, acute.

Specimens faded, color in life unknown.

Type specimens: Mountainside, 1.5 miles NE of Hodge, Jackson County, Alabama, 24 May 1961. Male holotype in USNM, male and

female paratypes in Hoffman collection, male paratype in Keeton collection.

Discussion: My first inclination was to consider this a form of the very variable *B. eutypa*, which it closely resembles. However, another collection made on the same day from a locality only a few miles from the type locality of *enodicuma* contains specimens typical of *eutypa* (see records under *eutypa*). Since the two forms are apparently sympatric, it seems necessary to recognize *enodicuma* as a full species.

***Brachoria divicuma*, new species**

(Figs. 6–8)

Diagnosis: Easily distinguished from all other species in the genus by the curious bifurcate distal end of the telopodite of the gonopods, which is completely unlike the bifurcate condition seen in *glendalea* (Chamberlin), to which this species does not seem to be closely related. The gonopod of *B. divicuma* resembles those of such old "*Tucoria*" species as *B. calceata* (Causey) and *B. viridicolens* (Hoffman) in its small size and very sturdy construction, but the distal end is completely different from the enlarged ends of the gonopods of those two species.

Description: Length of males, 40.5–43.0 mm (holotype 42.8); greatest width, 9.8–10.4 mm (holotype 10.3); L/W ratio, 3.9–4.4 (holotype 4.2).

Collum subellipsoid, posterior edges of paranota angled forward at their bases, ends of paranota rounded. Anterior marginal ridges moderately prominent.

Peritremata present but somewhat reduced on segment 2, better developed on other segments. Posterolateral corners of paranota rounded on segments 2 and 3, slightly less rounded on 4, becoming nearly a right angle (though not sharp) on segment 5 or 6, slightly produced caudad on segment 7 and succeeding segments.

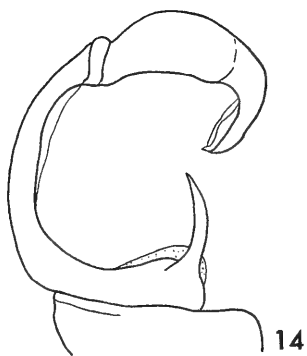
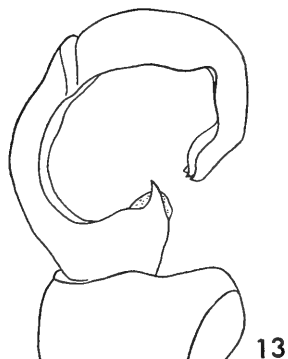
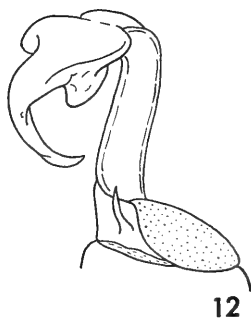
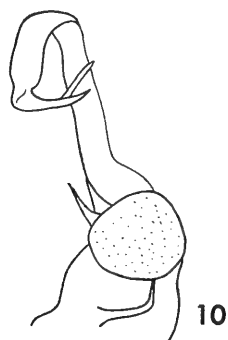
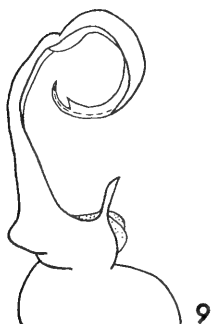
Sternum of 3rd legs with the usual processes; sternum of 4th legs with a pair of small contiguous medial processes; sternum of 5th legs depressed medially, with small mounds at bases of legs; sterna of 6th and 7th legs without processes, the 6th crossed by a horizontal ridge connecting the leg bases, the 7th slightly concave.

Coxal spines absent from pregenital legs but represented by a small knob on 7th, present on 8th legs and becoming larger on succeeding segments, nearly absent from last 2 legs. Trochanteral spines prominent.

Male gonopods stout but small (telopodite arc length about 1.78 mm). Telopodite curving mesoventrad to the cingulum, then mesad, then dorsad; distal half of postcingular portion becoming thinner; bifurcate distally, the anterior prong directed nearly dorsad, the posterior prong curving laterad and thus almost giving the appearance of a tooth in cephalic view; a prominent spine present on inner surface of postcingular portion at point slightly distal to its midpoint in one specimen, this spine absent in other two specimens. Basal spine short, blunt.

Color faded, but pattern was apparently trimaculate.

Type specimens: Mountainside, 1200 ft, 2 miles W of Jamestown,



Fentress County, Tennessee, 6 June 1964, Leslie Hubricht. Male holotype in USNM, male paratypes in Keeton collection and Hoffman collection.

Discussion: This species is of special interest both because of its very distinctive gonopods and because of the variation they show with reference to the spine on the inner surface of the telopodite, which is present in one specimen and absent in two. This is more variation than would be expected in specimens from the same locality, particularly when the three pairs of gonopods are practically identical in all other respects.

Brachoria calcaria Keeton

Brachoria calcaria Keeton, 1959, Proc. U. S. Nat. Mus., 109: 15, Figs. 1d-g.

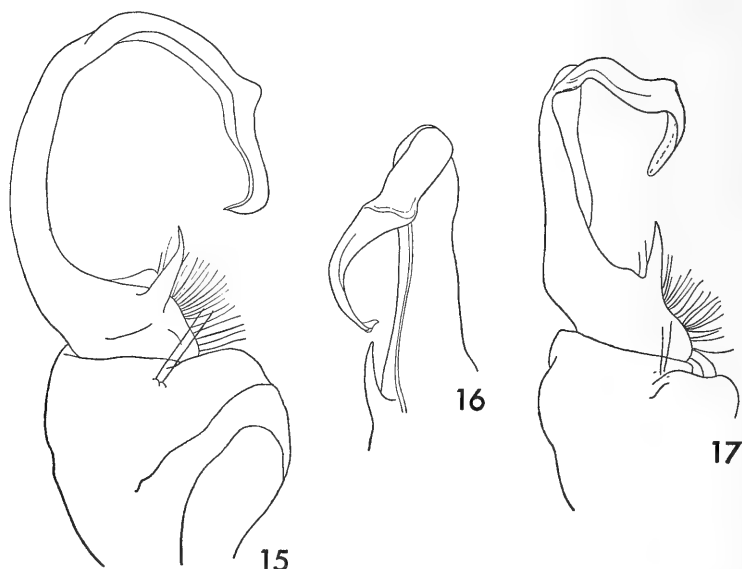
New records: WEST VIRGINIA: Monroe County: 2 miles N of Ballard on W. Va. Highway 12, 14 September 1962, R. L. Hoffman, 1 male. VIRGINIA: Montgomery County: Blacksburg, 13 January 1959, Hoffman, 1 male; 14 April 1957 and 21 May 1958, E. M. Raffensperger, 2 males; Dry Run, 5 miles NE of Blacksburg, 24-27 April 1957, Hoffman, 2 males.

Discussion: As mentioned in the original description, the diagnostic spurs on the precingular portion of the gonopod telopodite vary in number from 1 to 4. The new specimens reported here indicate that the thin flange on the postcingular portion is also variable. For example, the following combinations were found: several well-developed spurs and a prominent flange, two small spurs and a prominent flange, one very small spur and a small flange, two small spurs and no flange, one very small spur and no flange. The last specimen mentioned had such a tiny spur that at first I thought it had none, and, since it lacked a flange, it strongly resembled *B. separanda*. However the telopodite was heavier and thicker distally than is usual in *separanda*. *B. calcaria* may well prove to be only a southern form of *separanda*, although specimens from Summers and Monroe counties, West Virginia, have both spurs and the characteristically heavy *calcaria* telopodites, while *separanda* specimens from the relatively close Webster County lack spurs and have the much thinner telopodites characteristic of that species. Further collections from the area of West Virginia between the two known ranges (Fig. 28) should settle the matter.

The extreme color variability of *calcaria*, mentioned in the original description, takes on more interest with the recent description of *B. versicolor* Hoffman (1963), a related species with similar variability.

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FIGS. 9-10. *Brachoria glendalea*, left gonopod: 9, cephalic; and 10, mesal views. FIGS. 11-12. *Brachoria hoffmani*, left gonopod: 11, cephalic; and 12, cephalomesal views. FIGS. 13-14. *Brachoria hubrichti*, left gonopods, cephalic views: 13, specimen from Hamilton County, Tenn.; 14, specimen from Sequatchie County, Tenn.



FIGS. 15-16. *Brachoria ochra*, holotype, left gonopod: 15, cephalic; and 16, mesal views. FIG. 17. *Brachoria initialis*, holotype, left gonopod, cephalic view. FIGS. 15-17 drawn by R. L. Hoffman and published with his permission.

Brachoria eutypa eutypa Chamberlin

Brachoria eutypa Chamberlin, 1939, Bull. Univ. Utah, biol. ser., No. 3: 4, Fig. 4.

Brachoria eutypa eutypa, Keeton, 1959, Proc. U. S. Nat. Mus., 109: 21, Figs. 3a-g.

New records: ALABAMA: Jackson County: base of Sand Mt. 2 miles SE of Stevenson, 24 May 1961, L. Hubricht, 1 male. TENNESSEE: Knox County: 1 mile S of Halls Crossroads, 20 May 1961, L. Hubricht, 1 male. Unicoi County: near Davis Springs, Limestone Cove, 5 miles E of Unicoi, 18 May 1961, L. Hubricht, 1 male.

Brachoria glendalea (Chamberlin)
(Figs. 9-10)

Fontaria glendalea Chamberlin, 1918, Psyche, 25: 123.

Brachoria glendalea, Chamberlin and Hoffman, 1958, U. S. Nat. Mus. Bull. 212: 24.

Brachoria glendalea, Keeton, 1959, Proc. U. S. Nat. Mus., 109: 28, Figs. 4d-f.

New record: TENNESSEE: Bedford County: wooded hillside, 9 miles S of Shelbyville, 8 October 1960, 1 male.

Discussion: The gonopods of the specimen reported here differ from those of the type in being distally bifurcate (Figs. 9–10). The point from which the subterminal tooth arises is, however, noticeable as a small swelling in the type (see Keeton, 1959, Fig. 4f) and in the specimens from Tennessee, reported in the 1959 paper.

Brachoria hoffmani Keeton

(Figs. 11–12)

Brachoria hoffmani Keeton, 1959, Proc. U. S. Nat. Mus., 109: 31, Figs. 5d–f.

New records: KENTUCKY: Pike County: under stones on steep wooded hillside, 3 miles N of Virgie on U. S. 23, 8 April 1961, B. D. Valentine, 1 male, 2 females. VIRGINIA: Dickenson County: along Frying Pan Creek, 7.2 miles SE of Haysi on Va. Highway 80, and Crane's Nest River, approx. 5 miles W of Haysi, 21 April 1962, R. L. Hoffman, 3 males, 2 females.

Discussion: The specimens from Dickenson County, Va., are very similar to the types (from Buchanan County), but those from Kentucky show variations in the gonopod (Figs. 11–12), particularly the length of the distal half of the postcingular portion and the great development of the lobe on the inner surface of the basal half of the postcingular portion (which is only weakly developed in the type). Collection notes indicate the color in life as, "Paranotal (lateral and median) spots dark pink, legs tinged with pink, their bases pale dirty-white."

Brachoria hubrichti Keeton

(Figs. 13–14)

Brachoria hubrichti Keeton, 1959, Proc. U. S. Nat. Mus., 109: 33, Figs. 5g–i.

New records: TENNESSEE: Hamilton County: Signal Mt., 30 July 1959, R. L. Hoffman, 4 males. Sequatchie County: mountain side, 5.4 miles S of Dunlap, 3 April 1960, L. Hubricht, 3 males.

Discussion: The distal portions of the gonopods of these specimens differ somewhat from the type, and they differ from each other (Figs. 13–14). The basic plan is the same in all, however, and I consider this a case of intraspecific geographical variation not worthy of nomenclatorial recognition.

Brachoria initialis Chamberlin

(Figs. 17, 19–23)

Brachoria initialis Chamberlin, 1939, Bull. Univ. Utah, biol. ser., 5: No. 3: 3, Fig. 3.

Brachoria brachypus Chamberlin, 1947, Proc. Acad. Nat. Sci. Philadelphia, 99: 26, Fig. 9.

Brachoria benderi Causey, Ent. News, 61: 193, Figs. 1–2.

Brachoria ochra initialis, Keeton, 1959, Proc. U. S. Nat. Mus., 109: 11, Figs. 1a–c.

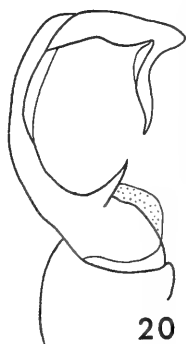
Brachoria cedra Keeton, 1959, *ibid.*, p. 17, Figs. 2a–c. **New synonymy.**



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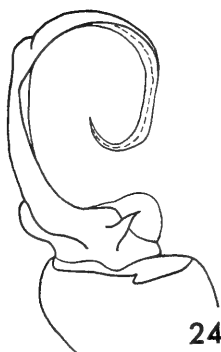
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New records: ALABAMA: Chilton County: below Lay Dam, 10 July 1960, L. Hubricht, 1 male; 7 miles E of Coopers, 10 July 1960, L. Hubricht, 1 male. Elmore County: 3.7 miles N of Wallsburg, 10 July 1960, L. Hubricht, 1 male. GEORGIA: Gordon County: wooded slope, 1.5 miles S of Oakman, 13 May 1961, L. Hubricht, 1 male, 1 female. Murray County: 5 miles NW of Fort Mountain State Park, 18 July 1961, R. E. Gordon, 1 male. MISSISSIPPI: Jefferson Davis County: upland oak woods, 8 miles S of Prentiss, 26 December 1959, L. Hubricht, 2 males, 1 female. Oktibbeha County: 9 December 1937, 1 male. TENNESSEE: Greene County: 2 miles W of Greeneville in cedar woods, 19 May 1961, R. L. Hoffman, 3 males (a note says, "black in life, with paranotal spots red or pink"). Hamilton County: wooded hillside, 3 miles NE of Sale Creek, 21 May 1961, L. Hubricht, 2 males, 3 females.

Discussion: *Brachoria initialis* is by far the most widespread species in this genus, occurring from southwest Virginia south through eastern Tennessee and northwestern Georgia into south-central Alabama and Mississippi (Fig. 27). There is considerable local variation, and this has resulted in the proposal of four different specific names which, in my judgment, are all referable to a single variable species. In my earlier paper, *initialis* and *cedra* were recognized as distinct. Study of more specimens and analysis of their variation on a geographic basis convinces me that *cedra* can no longer be maintained. (In the 1959 paper, I considered *initialis* a subspecies of *ochra*; see the discussion of *ochra* below for reasons why this was incorrect.)

The shape of the distal end of the gonopod, the distinctness of the subterminal angulation, the telopodite arc length, and the overall body proportions of *initialis* vary. As Figures 19–23 indicate, the variation in shape shows no geographic pattern and seems to reflect only differences in very local populations.

Contrary to my 1959 statement, variation in telopodite arc length is appreciable, and might seem to differentiate recognizable taxonomic entities. Particularly striking is the difference between the very small telopodites (1.3–1.5 mm) of specimens from Jefferson Davis County, Mississippi, and the unusually large ones (1.9–2.0 mm) of specimens from Greene County, Tennessee. The measurements of speci-

←

FIG. 18. *Brachoria electa*, left gonopod, cephalic view (included here for comparison with *B. initialis*). FIGS. 19–23. *Brachoria initialis*, left gonopods, cephalic views (to show geographic variation): 19, specimen from Chilton County, Ala.; 20, specimen from Greene County, Tenn.; 21, specimen from Jefferson Davis County, Miss.; 22, specimen from Oktibbeha County, Miss.; 23, specimen from Lee County, Ala. FIGS. 24–25. *Brachoria* species A, left gonopod: 24, cephalic view; 25, mesal view.

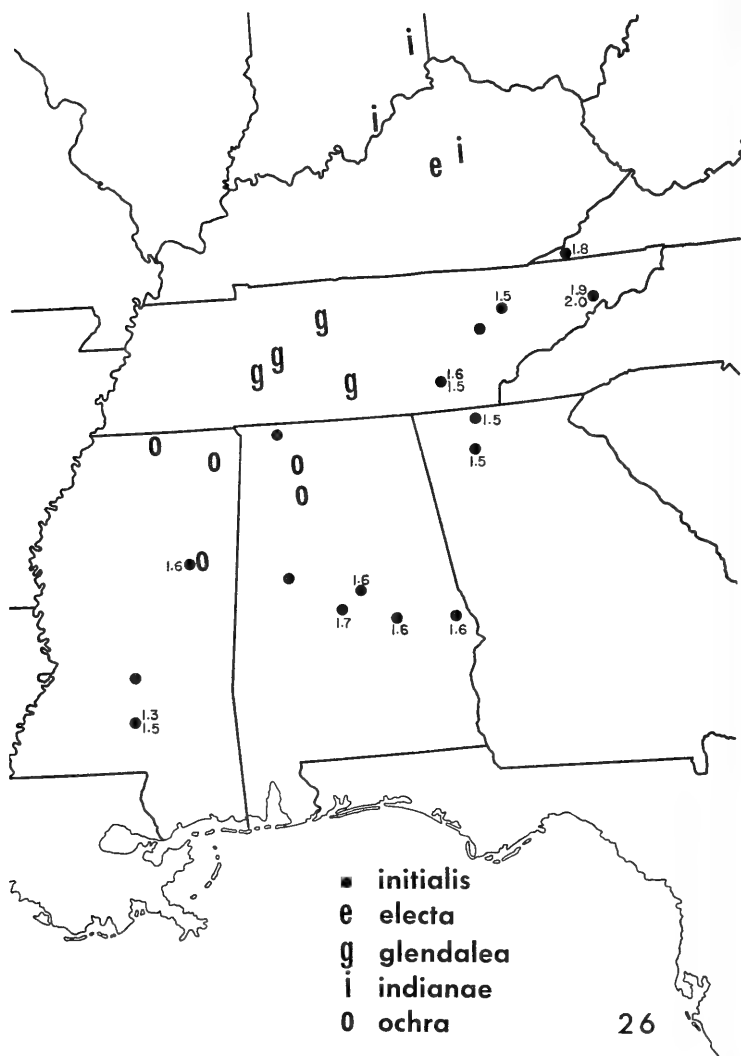


FIG. 26. Distribution of the *initialis* species group of *Brachoria*. Telopodite arc lengths for representative specimens of *B. initialis* are shown next to the symbols for that species; no clear geographic pattern for this character is evident.

mens from intervening parts of the range are intermediate. They do not, however, form a neat northeast-southwest cline, but vary in a more random fashion (Fig. 26), and no pattern deserving nomenclatorial recognition emerges. Similarly, when body proportions are plotted on a map (Fig. 27) no clear pattern is evident..

I think it likely that *B. electa* Causey (Fig. 18) is a synonym of *initialis*, but hesitate to pass judgment until specimens are available from the areas connecting the two known ranges. Both *B. ochra* and *B. glendalea* are probably closely related to *initialis*, but appear to be valid species; *ochra* is sympatric with *initialis* in Mississippi and in northwestern Alabama, and *glendalea* may be sympatric with it in central Tennessee.

The type of *B. cedra* was taken in cedar woods and the new specimens from Greene County, Tennessee, are also from cedar woods. This is a curious habitat for a member of this group of millipeds, most species of which are usually found only in deciduous forests. This matter should be investigated further.

Brachoria ochra (Chamberlin)

(Figs. 15-16)

Fontaria ochra Chamberlin, 1918, Psyche, 25: 123.

Brachoria sequens Chamberlin, 1939, Bull. Univ. Utah, biol. ser., 5: No. 3: 4, Fig. 2.

Anfractogon tenebrans Hoffman, 1948, Proc. Biol. Soc. Washington, 61: 94, Figs. 1-3. **New synonymy.**

Brachoria ochra, Chamberlin and Hoffman, 1958, U. S. Nat. Mus. Bull. 212: 25.

Brachoria tenebrans, Chamberlin and Hoffman, 1958, *ibid.*

Brachoria ochra ochra, Keeton, 1959, Proc. U. S. Nat. Mus., 109: 10.

Brachoria tenebrans, Keeton, 1959, Proc. U. S. Nat. Mus., 109: 48, Figs. 9a-d.

New records: MISSISSIPPI: Marshall County: mixed woods, 2 miles E of Slayden, 27 February 1961, L. Hubricht, 1 male, 1 female. Prentiss County: wooded hillside, 0.5 mile N of Franktown, 17 May 1964, L. Hubricht, 1 male.

Discussion: The gonopods of these specimens are much like those of the previously reported specimen of *tenebrans* from Lawrence County, Alabama, except that they are slightly slimmer distally and there is no trace of the subterminal tooth, which is weakly developed in the Lawrence County specimen and prominent in the holotype of *tenebrans*. The telopodite arc length of these specimens is also shorter than that of the type of *tenebrans*, being about 1.8 mm in Marshall County, Mississippi, as compared with 2.2 in Lawrence County and 2.5 in the type (from Winston County, Alabama). I am convinced that these slight differences between the Mississippi and Alabama specimens reflect geographic variation within a single species.

Having established that my specimens from northern Mississippi

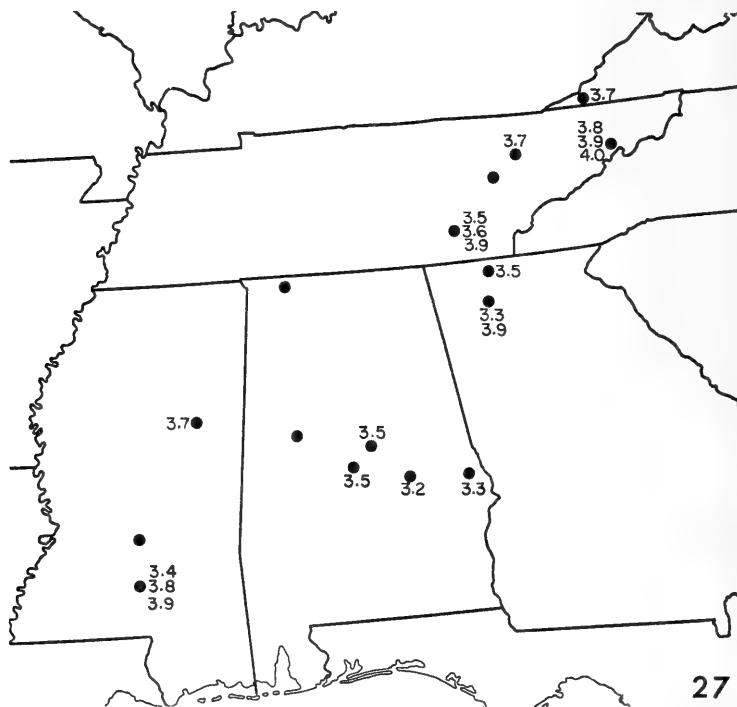
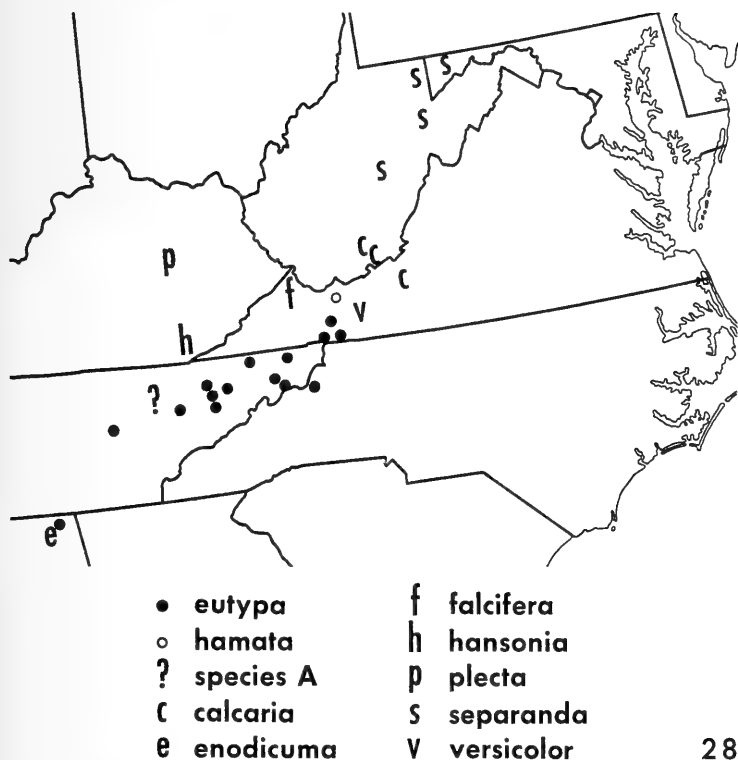


FIG. 27. Map showing geographic distribution of L/W ratio values for representative specimens of *Brachoria initialis*.

are conspecific with the type of *tenebrans*, I am forced, as a consequence, to regard *tenebrans* as a junior synonym of *ochra*. When I wrote my 1959 paper, I was unable to examine the type of *ochra* (or of its synonym *sequens*), and thus erroneously considered it to be conspecific with *initialis*, warranting at most only subspecific recognition. Recently, however, R. L. Hoffman visited Dr. Chamberlin in Utah and was able to examine the types of *ochra*, *sequens*, and *initialis*. He informed me (*in litt.*) that, "*ochra* is totally different from *initialis*, they clearly are not subspecies." Hoffman's conclusion is strongly supported by the drawings he prepared of the two types, which he has kindly given to me and allowed me to publish (Figs. 15–17). Hoffman's examination did confirm my synonymy of *sequens* with *ochra*; he said that their gonopods "were identical." My comparison of Hoffman's drawings of *ochra* (Figs. 15–16) with the gonopods of the specimens of *tenebrans* from northern Mississippi reveals no important differences.

As Fig. 26 shows, *ochra* and *initialis* are sympatric at the type locality of *ochra* (Oktibbeha County, Mississippi) and they are almost certainly sympatric in northwestern Alabama. This rules out the possi-



28

FIG. 28. Distribution of the *hansonia-eutypa-separanda* species group of *Brachoria*.

bility that they should be considered as subspecies of a single polytypic species.

Brachoria species A

(Figs. 24-25)

A single male specimen collected by Leslie Hubricht on a wooded hillside, 3 miles northwest of Caryville, Campbell County, Tennessee, shows a curious mixture of characteristics resembling *B. hansonia*, *B. falcifera*, and *B. eutypa*, as well as characteristics unlike any known species. The gonopod of this specimen is simple like that of *hansonia* but is more slender, and the distal end is more curved. The distal end of the telopodite forms a very slender sharp point, and lacks the blunt hooklike enlargement characteristic of *eutypa*. The general appearance of the gonopod strongly resembles that of *falcifera* in shape and dimensions, but lacks any demarcation of a sickle-shaped blade.

I hesitate to assign a name to this specimen as it may belong to any one of the three species here discussed. Furthermore, it may prove

to be an intermediate between two or more of these nominal species, such as *hansonia* and *eutypa*, and necessitate new synonymy. Or it may prove to be a new species in the complex to which the other three species belong. Only extensive collections in the area between the known ranges of *hansonia*, *eutypa*, and *falcifera* (see Fig. 28) can settle the matter by determining how each varies geographically.

Fontaria evides Bollman

Fontaria evides Bollman, 1887, Proc. U. S. Nat. Mus., 10: 621.

Discussion: *Fontaria evides* has remained unidentifiable since its description in 1887. Specimens labeled as types of *evides* have recently been found in the collection of the U. S. National Museum. One of these is a male with one gonopod; the gonopod is indistinguishable from those characteristic of *Brachoria separanda*. The type locality of *evides* is Mossy Creek (= Jefferson City), Tennessee; but the nearest known localities for *separanda* are in east-central West Virginia. Even if *calcaria* is considered a synonym of *separanda*, the distance of known *separanda* range from Jefferson City is still great, as milliped ranges go (and the "*evides*" gonopod is like typical *separanda*, not like *calcaria*). Furthermore, many days of diligent collecting around Jefferson City on numerous different occasions by Leslie Hubricht, R. L. Hoffman, and me have failed to produce a single specimen of *separanda*, but have produced specimens of *Brachoria initialis* from a neighboring county that fit Bollman's description of the color of *evides*. The situation is further confused by the fact that the USNM collection of "*evides*" contains more females than Bollman said he had.

All of these considerations cause me to hesitate from assigning *Fontaria evides* to *Brachoria* and synonymizing *separanda* with it on the basis of the USNM specimen. It seems entirely possible that specimens of *B. separanda* may have been accidentally mixed with some *evides* females, or that specimens have simply been mislabeled. On the other hand, I also hesitate from synonymizing *B. initialis* with *evides* on the basis of collections from Jefferson City; it remains possible that *separanda* may be found there some day, or that some other xystodesmid species from that locality will be shown to agree better with Bollman's description. For the present, it seems best to retain *Fontaria evides* as a *nomen inquirendum*.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NEW SPECIES OF THE CADDISFLY GENUS
POLYCENTROPUS FROM EASTERN
NORTH AMERICA (TRICHOPTERA, PSYCHOMYIIDAE)¹

BY HERBERT H. ROSS AND TOSHIO YAMAMOTO
Illinois Natural History Survey, Urbana

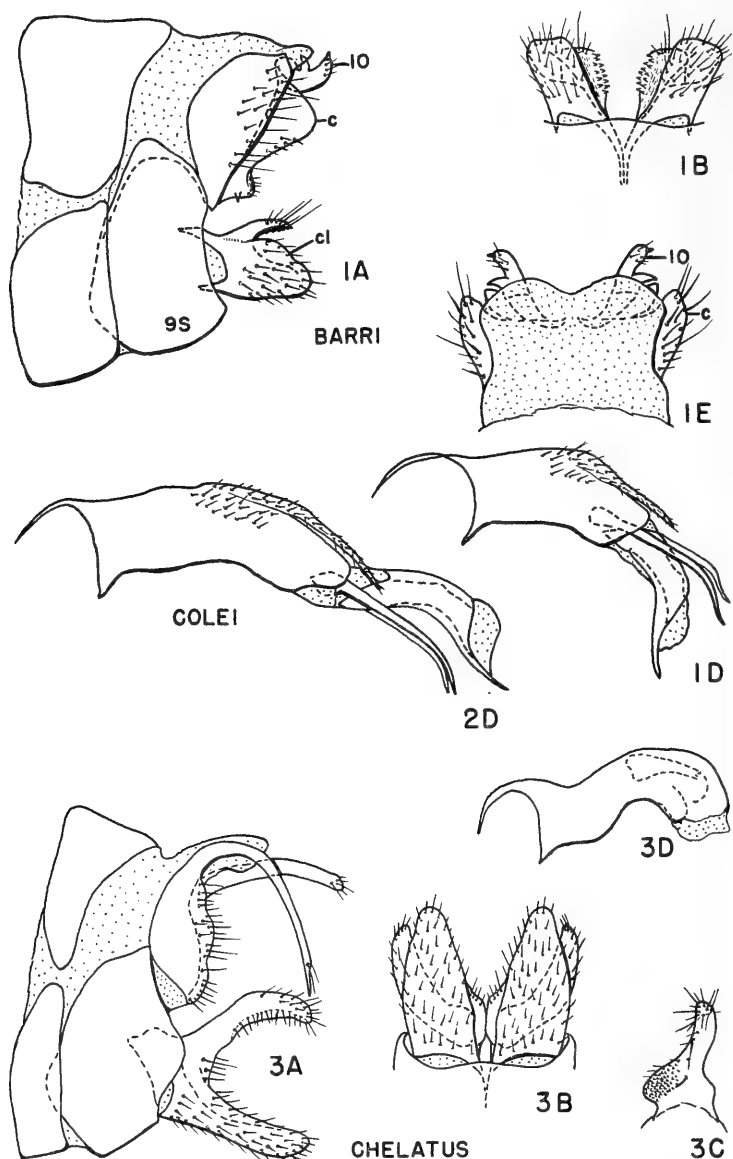
The following new species are remarkably uniform in size and color, in these respects resembling not only each other but closely related species with which they are compared. The following characteristics apply to all of them and will not be repeated in the individual descriptions: Length 8.5 mm. Color various shades of brown, semiobscure spots of lighter brown forming an irrorate pattern on the front wings; hind wings uniformly smoky; legs slightly lighter brown, the hind tibiae not markedly annulate. Venation, spur count, and other points of general structure typical for genus. To date no females have been associated with the males herein described as new species. Types of the new species are in the collection of the Illinois Natural History Survey.

***Polycentropus barri*, new species**

Male genitalia as in Fig. 1. Ninth sternite massive and wide. Clasper short and shallow, with a platelike dorsal process narrow in profile, its ventral aspect slightly longer than wide. Cercus massive and wide, the inner margin produced into a projecting lobe itself divided into a large dorsal and small ventral lobe. Sclerotized rods of tenth tergite short, hooked laterally, and having a stout spur near base. Aedeagus complex; its base short and angular, bearing a pair of dorsal, fingerlike, setate processes; eversible part forming a sclerotized tube produced into a tonguelike ventral projection; lateral arms slender and moderately sharply deflected toward apex.

Holotype male: John Rogers Cave, 1.6 miles ESE Hisel, Jackson Co., Kentucky, 20 May, 1964, T. C. Barr; in aphotic zone crawling beside stream on silt.

¹ This work has been supported by a research grant from the National Science Foundation.



FIGS. 1-3. Male genitalia of *Polycentropus*. A, lateral view of genital capsule; B, ventral aspect of claspers; C, widest face of basal process of clasper; D, lateral aspect of aedeagus; E, dorsal aspect of tenth tergite. c, cercus; cl, clasper.

This species is closely related only to *P. colei* Ross from which it differs in the narrower claspers, different shape of the cercus, the large lateral tooth on the lobes of the tenth tergite, and the shorter basal part of the aedeagus. In the original description of *P. colei* the expanded aedeagus was not drawn; this part is here illustrated for comparison, Fig. 2.

We take great pleasure in naming this unique species in honor of its collector, the ardent speleologist, Dr. T. C. Barr.

***Polycentropus chelatus*, new species**

Male genitalia as in Fig. 3. Ninth sternite massive and wide. Clasper with ventral body short, basal process high and large, lateral aspect chelate, ventral aspect of basal portion tapering gradually to a blunt apex; widest face of basal process with sessile base, rounded rugose mesal lobe, and elongate, fingerlike, rounded apex. Cercus with basal portion elliptic, its lateral edge produced posteriorly so that it completely hides the mesal lobe when viewed laterally. Aedeagus short and sinuate.

Holotype male: Sugar Tree, Decatur Co., Tennessee, along Kentucky Lake, tributary of Morgan Creek, 5 May, 1958, Ross *et al.* Adult dissected from pupal skin.

This species belongs to the *maculatus* group in which it is closely related only to *P. neiswanderi* Ross, from which it differs in the higher and longer basal process of the clasper, the elliptic base of the cercus and the much more sinuate lateral aspect of the aedeagus.

***Polycentropus chenoides*, new species**

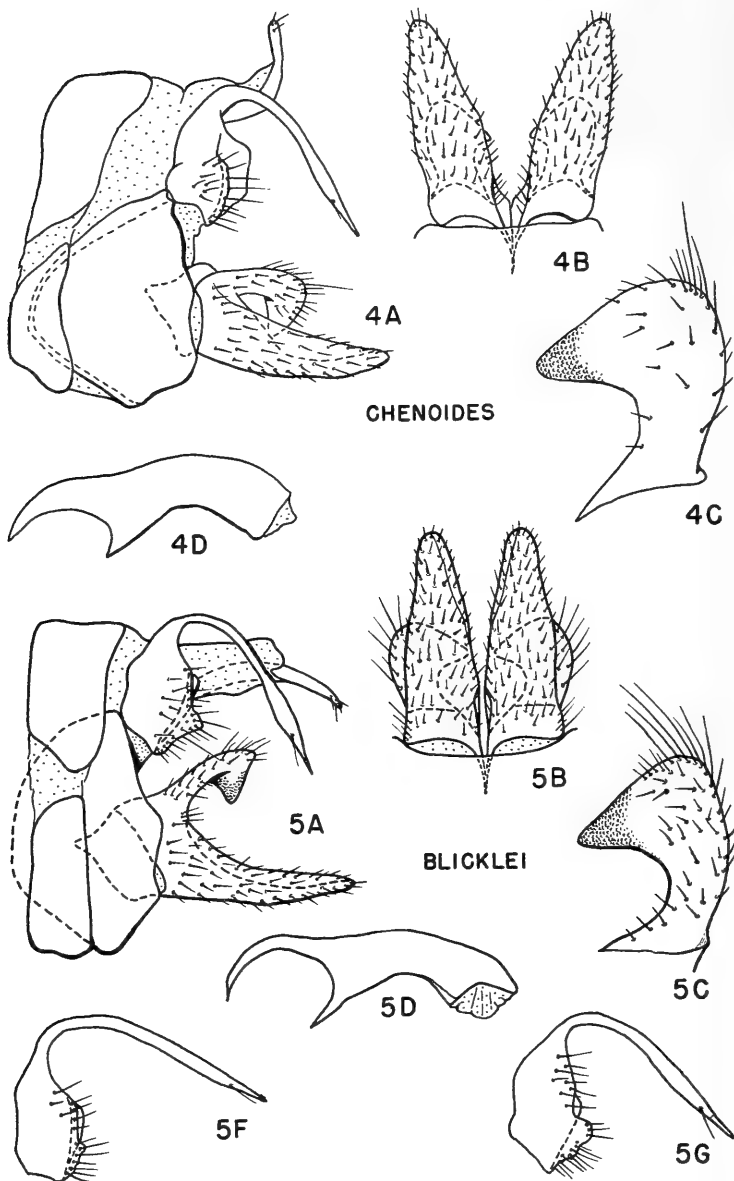
Male genitalia as in Fig. 4. Ninth sternite massive and unusually wide. Clasper with ventral portion moderately long, its lateral aspect tapering gradually to apex, its ventral aspect parallel-sided to about middle, then gradually tapering to a blunt apex; basal lobe moderately short, with a fairly long narrow base, the apex expanded into a broad mesal lobe having a rugose mesal point, its flat surface resembling a goose's head, the whole structure deflected so that its point is below the dorsal profile of the clasper body. Cercus with basal portion short and wide, the mesal lobe extending a considerable distance beyond the ridge marking the lateral portion. Aedeagus simple and slightly curved.

Holotype male: Oriente, Long Island, New York, 13 May 1947, no. 26341 Roy Lathan.

Another member of the *maculatus* group, this species is most closely related to *P. maculatus* Banks, differing especially in the wide, projecting mesal portion of the cercus and the deflected basal lobe of the clasper.

***Polycentropus blicklei*, new species**

Genitalia as in Fig. 5. Ninth sternite large and deep. Clasper with ventral portion long and tapering evenly from both lateral and ventral views; basal process fairly long, and projecting considerably above



clasper body, its produced face with a moderately long, narrow stalk, the apical portion produced into a pointed mesal lobe ending in a rugose area. Cercus with basal portion fairly broad, mesal lobe mostly hidden behind lateral lobe, the latter with a posterior projection near middle. Aedeagus tubular and only slightly curved.

Holotype male (described above): Plymouth, New Hampshire, 6 August 1947, R. L. Blicke and W. J. Morse. *Paratypes*: Lee, New Hampshire, 7 July 1951, W. J. Morse, 1 male; Wall Doxey State Park, Holly Springs, Mississippi, 21 May 1957, H. H. Ross and L. J. Stannard, 1 male.

This species also belongs to the *maculatus* group; from *P. elarus* Ross, which it resembles in clasper proportions and somewhat in shape of aedeagus, it differs in the tapering clasper body and wider apex of the clasper process; from *P. maculatus*, which it resembles in the shape of the dorsal process of the clasper, it differs in the straighter aedeagus, narrower clasper and shape of the cercus. The type series shows variations in the width of the basal part of the cercus. In the holotype, Fig. 5A, the structure is unusually wide; in the Lee, N. H. specimen, Fig. 5F, the base is only moderately wide, and in the Mississippi paratype, Fig. 5G, the cercus is almost midway between the two New Hampshire specimens.

Although collections of the *maculatus* group are not sufficiently numerous to place much reliance on negative records, nevertheless, the description of these three specimens suggests strongly that the main range of the species is at present in the northeastern states and that the Mississippi record represents a relict population that may have reached the area during cooler periods of the Pleistocene. This supposition is heightened by the fact that the Mississippi specimen was collected at a small, cold, spring-fed stream issuing from sandstone strata in Wall Doxey State Park.

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FIGS. 4, 5. Male genitalia of *Polycentropus*. A, lateral view of genital capsule; B, ventral aspect of claspers; C, widest face of basal process of clasper; D, lateral aspect of aedeagus; F, G, lateral aspect of cercus F of paratype from Lee, New Hampshire, G of paratype from Holly Springs, Mississippi.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

OPSANUS ASTRIFER, A NEW TOADFISH FROM
BRITISH HONDURAS¹

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Institute of Marine Science, University of Miami

Introduction and Acknowledgments

In June, 1961, the junior author accompanied Mr. and Mrs. E. N. Belcher, Jr., and party on a cruise on the yacht *PIOUS PUFFIN* and made a series of collections of reef fishes along the Caribbean coast of Central America. Among the many interesting fishes collected was the new toadfish (Batrachoididae) described below. We are indebted to the Belchers for making this trip possible and to Leonard P. Schultz and Ernest A. Lachner for aid during our various visits to the United States National Museum. Mrs. Priscilla R. Holland prepared the histological sections.

Opsanus astrifer, new species

Starry toadfish

(Figures 1-2, Table 1)

Holotype: USNM 259421-F1, an adult female, 232 mm standard length, collected at Turneffe Island, British Honduras, 200 yards ESE of Cay Bokel in a coral cave in 15 feet, 30 June 1961, by W. A. Starck II and E. N. Belcher III (field number: WAS-Carib-17).

Paratypes: UMML 9415 (1, 73 mm) and ANSP 102736 (3, 24-32 mm) collected with the holotype.

Diagnosis: A large species of *Opsanus* of dark brown color with numerous small white protuberances on the head and body. Fin-ray formula: D—III, 30-32, A—24-25, P—22-22, V—I, 2; Vertebrae—37-39. Body scaleless.

Description: Counts and measurements of the type specimens are given in Table 1. There are two rays and one short concealed spine in the pelvic fin. The anterior ray is thickened and provided externally with a fleshy rugose pad.

¹ Contribution No. 650 from The Marine Laboratory, Institute of Marine Science, University of Miami.

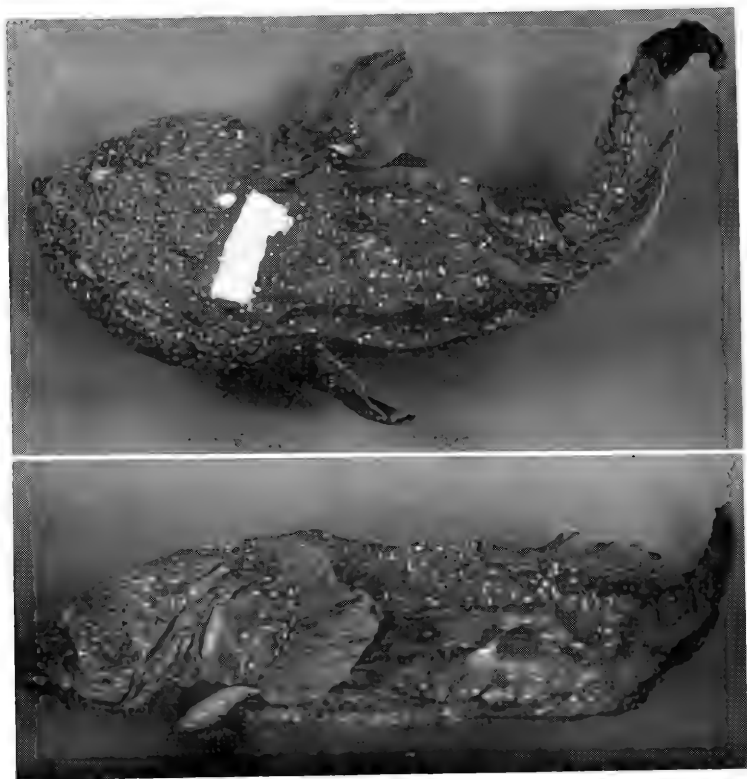


FIG. 1. Dorsal and lateral views of the holotype of *Opsanus astrifer*, USNM 259421-F1, an adult female, 232 mm in standard length, from Turneffe Island, British Honduras. The broad white areas in the dorsal view result from skin having been removed for microscopic study.

The body color of the holotype and largest paratype is dark brown throughout except for the belly, chest and throat. At first glance the brown appears to be uniformly dark but careful examination shows blotching on the side. The underparts are mottled brown and cream color in the holotype and are progressively more uniformly white in the smaller paratypes. The head, body and fin bases are covered with white pimples. These are most densely distributed on the upper surface of the head, most sparsely distributed posteriorly on the body and absent from the distal portions of the fins and from the belly, chest and throat. They are best developed in the holotype. The smaller paratypes lack the pimples but are spotted with white and the smallest retains a blotched color pattern reminiscent of *Opsanus beta*. All fins

TABLE 1. Counts and measurements (in hundredths of standard length) of the type specimens of *Opsanus astrifer* and of the holotype of *Opsanus barbatus*

| | <i>O. astrifer</i> | | | | | <i>O. barbatus</i> |
|----------------------|-----------------------|--------------|----------------|-------|-------|--------------------|
| | USNM 259421- FI | UMML 9415 | ANSP 102736 | | | USNM 81009 |
| Standard length (mm) | 232.5 | 73.1 | 37.0 | 31.5 | 24.0 | 339.0 |
| Head length | 38 | 37 | 37 | 36 | 38 | 38 |
| Snout tip to anus | 58 | 52 | 53 | 49 | 52 | — |
| Eye diameter | 4.8 | 6.2 | 9.5 | 7.6 | 10.3 | 4.7 |
| Pectoral-fin length | 15 | 17 | 19 | 18 | 22 | — |
| Pelvic-fin length | 17 | 16 | 18 | 21 | 24 | — |
| Dorsal soft rays | 32 | 31 | 31 | 30 | 31 | 33 |
| Anal rays | 25 | 25 | 24 | 24 | — | 27 |
| Pectoral rays | 22-22 | 22-22 | 22-22 | 22-22 | 22-22 | — |
| Vertebrae | 39 | 38 | 39 | 37 | — | 39 |

are blackish-brown except for the pelvics which may be partly pale colored.

The oral cavity is pale, somewhat dusky anteriorly on the floor of the mouth. The gill chamber is pale. The peritoneum is colorless except for melanin along the belly wall in the holotype.

The axillary pore is well developed but there are no glandular canals and openings along the pectoral rays. The lateral-line system is represented by the well-defined rows of sensory papillae on the body, the upper branch containing 32-37 papillae, the lower 34-37. Each papilla is bordered by the cirri which are longer on the anterior part of the body. On the head the papillae are more generally distributed and form well-developed rows of barbels along the fins and on the snout of this well-bearded species. Other papillae are on the body but they do not form organized tracts. On the head the lateral-line system is complex. In addition to well-developed head pores there are other openings from which small buds protrude. While similar structures are found in other species of *Opsanus*, the entire system seems especially advanced in *astrifer*.

The premaxillae bear a single row of small teeth for most of their length; there is a short second row anteriorly. The dentary teeth are larger, single-cuspid with an incisor-like edge and again in a single row except anteriorly where there is a well-developed second and outer row. The vomer and palatine teeth are arranged in a single unbroken U-shaped row of single-cuspid teeth.

Habitat: All specimens of *Opsanus astrifer* were collected at Turneffe Island, which consists of a large atoll-shaped group of smaller keys off the coast of British Honduras. It is encircled by a fringing reef and, beyond

that, by deep water (100 to 400 fathoms). The lagoon is shallow and carpeted with the marsh grass *Thalassia*.

The collection concerned was made just outside the fringing reef about 200 yards ESE of the islet, Cay Bokel. Water depth was about 15 feet and large corals, *Acropora*, *Agaracia* and *Montastrea*, dominated the area. The specimens of the new *Opsanus* were found lying in caverns beneath a large head of *Montastrea* and under the base of a dense stand of *Acropora*. The largest specimen was still alive, but stunned, when collected and bit viciously at a wooden net handle.

Biology: The holotype is a spent female. The ovary is in two portions, the anterior solid portion containing undeveloped ova. An early summer or late spring spawning shows that this species, unlike its northern allies, has adapted to warm-water life. This may also be true for the more southern *barbatus*.

Etymology: The name *astrifer* is from the Latin words meaning star and to bear.

Discussion: *Opsanus astrifer* is closest to *O. barbatus* Meek and Hildebrand. All other Atlantic species (*beta*, *tau*, *pardus*, *phobetrion*) have decidedly fewer dorsal and anal rays (see Walters and Robins, 1961: 3, Table 1).

The holotype and only specimen of *O. barbatus* was re-examined. Meristic data are given in Table 1. This large specimen (339 mm in standard length) is larger than the holotype of *astrifer*, yet possesses none of the white spots than earn *astrifer* its name. In addition to the color difference, *barbatus* has more anal (27 vs. 24–25) and dorsal (33 vs. 31–32) soft rays.

Study of a large number of sections of the skin of *astrifer* show that its white spots are associated with glandular structures. The basement pigment layer, very intense in *astrifer*, breaks up into a series of spots at the edge of the section through the white spot and disappears entirely across its center. Study of serial sections shows a pit located centrally in the spot and this pit leads into a larger area of glandular cells below the pigment layer and frequently to one side of it so that a number of sections must be followed to trace it. The white spots of *astrifer* are thus associated with definite dermal structures and not related to any parasite infestation. The function of the structures is unknown at present.

Considering all these differences and the conservative nature of meristic features in *Opsanus*, we describe *astrifer* as a species distinct from *barbatus*.

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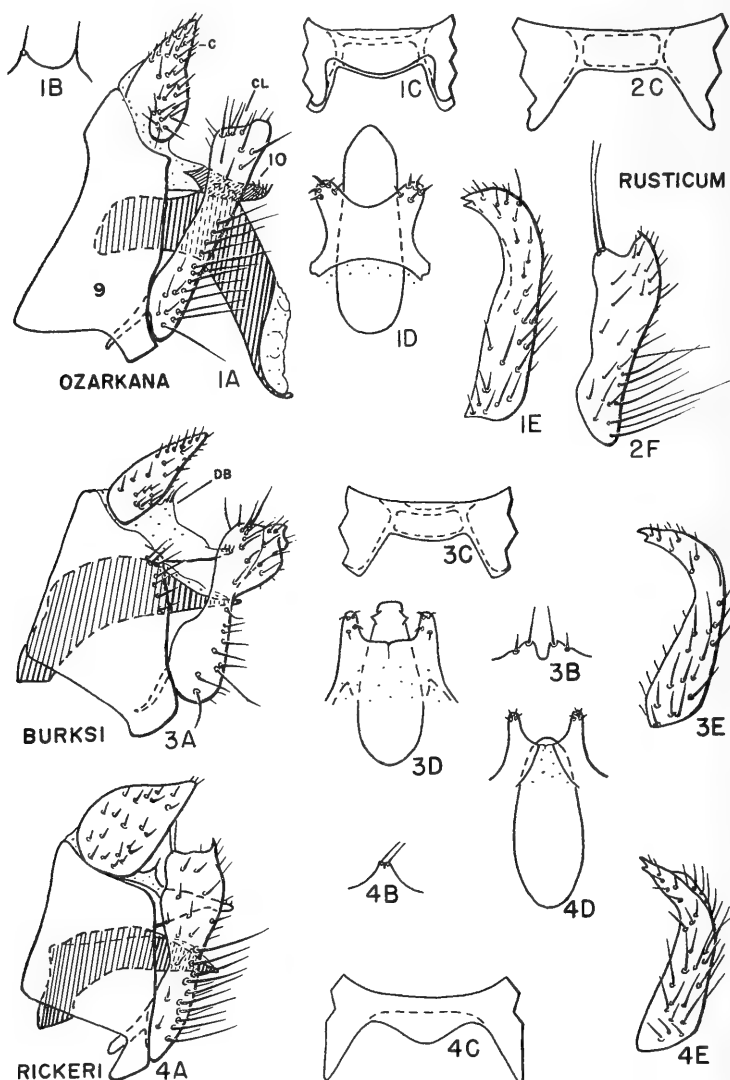
THE *MICRASEMA RUSTICUM* GROUP OF
CADDISFLIES (BRACHYCENTRIDAE, TRICHOPTERA)¹

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Of the nine species of *Micrasema* McLachlan known from eastern North America, the most northern one, *M. sprulesi* Ross has affinities with northern and western species whereas the other eight, occurring chiefly in the temperate deciduous forest, form a compact cluster of species comprising the *rusticum* group having no apparent close affinities with any other North American branch of the genus. In an attempt to reach a better understanding of the relationships of these groups, descriptions of the twenty or more Old World species were consulted and an attempt was made to deduce the basic dichotomies of the genus. The morphological information contained in the published illustrations was insufficient to arrive at probable conclusions regarding the affinities of most species, but a few interesting relationships were suggested for a number of them.

By comparing the male genitalia of *Micrasema* with those of *Brachycentrus* and genera in related families, the following would seem to be the primitive states of certain structures: (1) dorso-basal process of tenth tergite elongate, bearing many setae; (2) cerci definitely separated on the meson, with a well-defined piece of the ninth tergite between them; (3) tenth tergite bilobed at apex; and (4) clasper with an apical segment, perhaps represented by the mesal flap or lobe present in such species as *M. borneensis* Banks and *vestitum* Navas. The Japanese *M. hanasensis* Tsuda has all these characters except the vestige of the apical segment of the clasper, and on this basis represents a primitive surviving branch of the

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FIGS. 1-4. Male genitalia of *Micrasema* species. A, male genitalia, lateral aspect; B, dorsobasal lobes of tenth tergite; C, ninth sternite, ventral aspect; D, tenth tergite and aedeagus, dorsal aspect; E, right clasper, ventral aspect. Abbreviations: 9, 10, ninth and tenth segments; C, cercus; CL, clasper; DB, dorsobasal process.

genus. The Bornean *M. borneensis* possesses all of the above primitive characters except that the cerci are fairly close together at the base. This species also is therefore a good candidate for being one of the most archaic branches of the genus. The remainder of the species we have seen are alike in having the dorsobasal lobe much reduced and, if evident, bearing a maximum of two setae at the apex (Fig. 3B).

In three North American lineages, *M. scissum* McLachlan, *M. sprulesi* Ross, and *M. bactro* Ross and its allies, the dorsobasal process is apparently incorporated as only an indistinct wart of the tenth tergite, and the clasper has one or more additional small lobes on the anterodorsal face near the apex. These three lineages appear to constitute a distinctive monophyletic branch. In the two European species, *M. servatum* Navas and *vestitum* Navas, the dorsobasal process is short, with two apical spines, but the apical segment of the clasper is a well-delineated lobe. In the western North American *M. aspilus* Ross, the apex of the clasper is split; one of the short branches of this fork may represent an apical segment whose delineating sutures are gone.

The group of species containing *M. rusticum* Hagen has many members possessing the small, two-spined dorsobasal process, but lacks any sign of a division of the clasper and the basis of the cerci either touch on the meson, or are actually fused for a short distance. This group can be visualized as an offshoot of the *servatum* branch in which the claspers lost their apical lobe; *M. aspilus* could represent an intermediate step in this evolution. The only indubitably close relative of the *rusticum* group that we have seen is the Japanese *M. quadriloba* Martynov. This differs markedly in having the dorsobasal process fused with the cerci, which are themselves moderately well fused and hoodlike, and in having the tenth tergite produced into a long narrow point, not at all bilobate. It is possible that the European *M. tristellum* McLachlan belongs near *M. quadriloba*. There is some suggestion, further, that the European *M. minimum* McLachlan may be even more similar to *M. rusticum* than are either *M. tristellum* or *M. quadriloba*. At the present, however, the only comparisons that seem reliable indicate only that *M. quadriloba* represents a closely related sister branch of *M. rusticum*.

To translate this information into a pattern of probable dispersals, ecological information must be invoked. The entire *rusticum* branch is confined almost completely to the eastern temperate deciduous forest and *M. quadriloba* plus the two possible European representatives of the branch occur in sufficiently low latitudes that they would appear to be ecological equivalents. This is suggestive that the progenitor of the *rusticum* group spread across the Holarctic region during mid-Tertiary when the temperate deciduous forest was widespread across this entire region. Where in this large area the progenitor of the entire branch

originated is impossible to tell. On the basis of phylogenetic sequence, the *scissum-sprulesi-bactro* branch appears to have originated earlier and to have evolved in western North America. The *scissum* and *sprulesi* branches appear to have evolved as northern boreal elements, but on the evidence at hand no time can be suggested reliably as to when the ancestor of *M. sprulesi* spread to eastern North America.

THE RUSTICUM GROUP

The eight species known for this group appear to constitute three branches. In one branch, comprising *M. charonis* Banks, *scotti* Ross, and *bennetti* Ross, the apex of the clasper has developed a footlike apical projection; *M. burksi* n. sp. has all the appearances of representing an early stage in this development. In another branch, containing only *M. wataga* Ross, the dorsobasal process is elongate, fingerlike, and terminates in a single long spine; the tenth tergite has other distinctive characters. In the third branch, containing *M. rusticum* Hagen, *rickeri* n. sp., and *ozarkana* n. sp., the reduction of the dorsobasal process has become progressively reduced. The entire *rusticum* group has apparently evolved entirely within the confines of the eastern deciduous forest and its northern ecotonal areas.

DESCRIPTIONS OF NEW SPECIES

During the course of this study, three new species of the genus *Micrasema* were discovered. These are described below. The descriptions are of the holotype and allotype specimens. The types are deposited in the collection of the Illinois Natural History Survey.

Micrasema ozarkana, new species

Male: Length, 4.3 mm. Head, thorax, and abdomen brown; antennae, mouthparts, legs below the coxae, and wings light brown. Maxillary palpi 3-segmented. Abdominal tergites uniform in structure. Genitalia as in Fig. 1. Ninth segment broad laterally, narrow above and below. Cerci divergent on the meson, touching near base; triangular in dorsal aspect. Tenth tergite divided into a pair of stout divergent sclerotized lobes, each bearing a group of sharp setae at the apex (Fig. 1D). At the base of the tenth tergite arises a pair of medium-sized dorsobasal semimembranous lobes bearing one seta at each of their apices (Fig. 1B). Aedeagus tubular and simple with tip tapered and blunt (Fig. 1D). Claspers, in lateral aspect, wide basally narrowing in the middle and widening again slightly at the tip (Fig. 1A); in ventral aspect curved inward at the tip (Fig. 1E.) Ninth sternite broadly U-shaped with lateral edges only slightly divergent and anterior edge bowed very little (Fig. 1C). Seventh and eighth sternites with a thick cushion of hairs.

Female: Length 4 mm. Color and general structure similar to male. Ninth tergite triangular; tenth tergite roughly triangular, posterior edge divided into two lobes by mesal incision.

Holotype: Male; Greer Springs, Missouri; 7 June 1937; H. H. Ross. *Allotype*: Female; same data as for holotype. *Paratypes*: same data as for holotype, 52 ♀♀; Big Springs, Missouri; 15 July 1964; J. D. Unzicker and T. Yamamoto, 15 ♂♂, 1 ♀; Mammoth Springs, Arkansas; 14 July 1964; J. D. Unzicker and T. Yamamoto, 2 ♂♂, 2 ♀♀.

In Ross' key (1947) this species runs to *M. rusticum*, but differs from *rusticum* in the divergent lobes of the tenth tergite, the shape of the aedeagus in lateral aspect (in *rusticum* it is almost identical with that of *M. burksi*, Fig. 3A), the shape of the ninth segment in lateral aspect (*M. rusticum* as in Fig. 2A), the shape of the clasper in lateral and ventral aspects, the shape of the ninth sternite (*M. rusticum* as in Fig. 2C); and the absence of a well-defined sclerotized band along the posterior edge of the sixth sternite.

Some variation has been noted in *M. ozarkana*. The holotype has one seta on each of the dorsobasal semimembranous lobes at the base of the tenth tergite whereas a number of the paratypes have two setae on each process.

Micrasema burksi, new species

Male: Length 3.5 mm. Color as in *M. ozarkana*. Maxillary palpi 3-segmented. Abdominal tergites and cerci very similar to *M. ozarkana* except that in *M. burksi* the base of the cerci is broader in lateral aspect (Fig. 3A). Genitalia as in Fig. 3. Ninth segment narrow at top and broad at base in lateral aspect (Fig. 2A). Tenth tergite divided into a pair of stout almost parallel sclerotized lobes, each bearing a group of sharp setae at the apex (Fig. 3D). At the base of the tenth tergite there arises a pair of stout dorsobasal semimembranous lobes each bearing a pair of setae (Fig. 3B). Aedeagus tubular, with a blunt end and a pair of small pointed lateral projections just before the tip (Fig. 3D). Claspers in profile narrow at base and increasing in width to the tip (Fig. 3A); in ventral aspect curved sharply inward near tip (Fig. 3E). Ninth sternite broadly U-shaped, with anterolateral edges divergent and anterior edge only slightly bowed (Fig. 3C). Sixth sternite with median posterior projection.

Female: Length 3.25 mm. Color and general structure as in male. Apparently identical to the female of *M. ozarkana*.

Holotype: Male; Parksville, Tennessee; 25 April 1938; H. H. Ross and B. D. Burks. *Allotype*: Female; same data as for holotype. *Paratypes*: same data as for holotype, 11 ♂♂, 1 ♀; Neels Gap, Cattahoochee National Forest, Georgia; 22 May 1946; P. W. Fattig, 1 ♂, 1 ♀.

M. burksi approaches *M. bennetti* Ross but in *bennetti* the lobes of the tenth tergite are divergent, the aedeagus lacks lateral projections, the apex of the clasper is produced into a well-developed lobe resembling the toe of a boot, the apex of the clasper has four teeth, and the process of the sixth sternite is atrophied.

In *M. burksi* the number of apical setae on the dorsobasal lobes varies. The holotype has two setae on each process while several para-

types have one seta on each lobe. The shape and length of the posterior median process of the male sixth sternite also varies, ranging from short and blunt to medium length and pointed.

***Micrasema rickeri*, new species**

Male: Length 3 mm. Color and general structure as in *M. ozarkana*. Genitalia as in Fig. 4. Ninth segment broad laterally, narrow above and conspicuously constricted below. Cerci divergent, fusing on meson approximately halfway between base and tip; triangular in dorsal aspect, and short and stout and lateral aspect (Fig. 4A). Tenth tergite divided into a pair of rounded slightly divergent sclerotized lobes, each bearing a group of sharp setae at the apex (Fig. 4D). From the base of the tenth tergite arises a pair of short closely appressed dorsobasal semimembranous lobes each bearing one seta (Fig. 4B). Aedeagus tubular and simple. Claspers, in lateral aspect, narrow at base and increasing in width toward the tip which is wide with a posterodorsal projection (Fig. 4A); in ventral aspect clasper curved inward at tip (Fig. 4E). Ninth sternite broadly U-shaped with lateral edges divergent and anterior edge bowed quite strongly (Fig. 4C). Sixth sternite with a short blunt process on the posteromedian edge.

Female: Length 2.75 mm. Color and general structure similar to *M. ozarkana*.

Holotype: Male; Talullah River, north of Clarksville, Georgia; 3 April 1949; W. E. Ricker and D. C. Scott. *Allotype*: Female; Soque Creek, Habersham Co., Georgia; 3 April 1949; W. E. Ricker. *Paratype*: same data as allotype, 1 ♂.

This species is close to *M. rusticum* but differs in the slightly divergent lobes of the tenth tergite; the closely appressed lobes at the base of the tenth tergite; the shape of the ninth sternite; the wide cerci, in lateral aspect; and the shape of the clasper in lateral and ventral aspects.

***Micrasema rusticum* (Hagen)**

Examination of a number of collections has indicated variation in several characters. The male clasper may be shaped as in Fig. 2F, a posterior median process of the male sixth sternite may be present or absent, and the dorsobasal lobes may each bear one or two setae.

KEY TO SPECIES—*MICRASEMA RUSTICUM* GROUP

1. Apex of aedeagus having a pair of pointed, lateral projections (Fig. 3D) **burksi**, n. sp.
 Apex of aedeagus without lateral points 2
2. Lateral aspect of clasper having apex straight, continuing the posterior contour of body of clasper 5
 Lateral aspect of clasper having apex bent to form a posterior projection, the whole looking like an inverted boot (Ross 1947, Fig. 42) 3

3. Cercus nearly V-shaped, with posterolateral margin deeply incised (Ross 1947, Fig. 41A) **scotti** Ross
 Cercus nearly triangular, the posterolateral margin, nearly straight
 (Ross 1947, Fig. 42A) 4
4. Clasper having heel of boot small, toe with only two teeth, these
 on mesal side and hardly visible on lateral aspect .. **charonis** Banks
 Clasper having heel of boot large and rounded, toe with four teeth
 projecting sufficiently to be visible on lateral aspect (Ross 1947,
 Fig. 42) **bennetti** Ross
5. Dorsobasal processes of tenth tergite well separated, long and
 fingerlike, each bearing a single, long apical bristle (Ross 1944,
 Fig. 895) **wataga** Ross
 Dorsobasal processes of tenth tergite either each bearing 2 apical
 bristles, or short and conical (Fig. 4B, or Ross 1944, Figs. 893,
 894) 6
6. Dorsobasal processes of tenth tergite fused into a single, small
 hump bearing 2 small setae (Fig. 4B) **rickeri**, n. sp.
 Dorsobasal processes of tenth tergite well separated, low, each
 bearing 1 or 2 small setae (Fig. 1B) 7
7. Lobes of tenth tergite divergent (Fig. 1D); profile of aedeagus
 sharply angulate (Fig. 1A) **ozarkana**, n. sp.
 Lobes of tenth tergite not divergent (Ross 1944, Fig. 893); profile
 of aedeagus arcuate, much as in Fig. 3A **rusticum** (Hagen)

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SCLERACTINIAN CORAL OF THE GENUS
FLABELLUM FROM NEW ZEALAND, WITH A NEW
RECORD OF *STEPHANOCYATHUS*

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Several specimens of stony corals collected by the New Zealand Marine Department were sent to the junior author for identification. During a visit to the Smithsonian Institution in 1964, she took the opportunity to compare these specimens with reference collections in the Museum of Natural History and other collections of New Zealand corals described by Squires and Keyes (in press). The present descriptions are based largely upon the Marine Department collections and also upon specimens taken by the New Zealand Oceanographic Institute.

FAMILY FLABELLIDAE BOURNE, 1905

Genus *Flabellum* Lesson, 1831

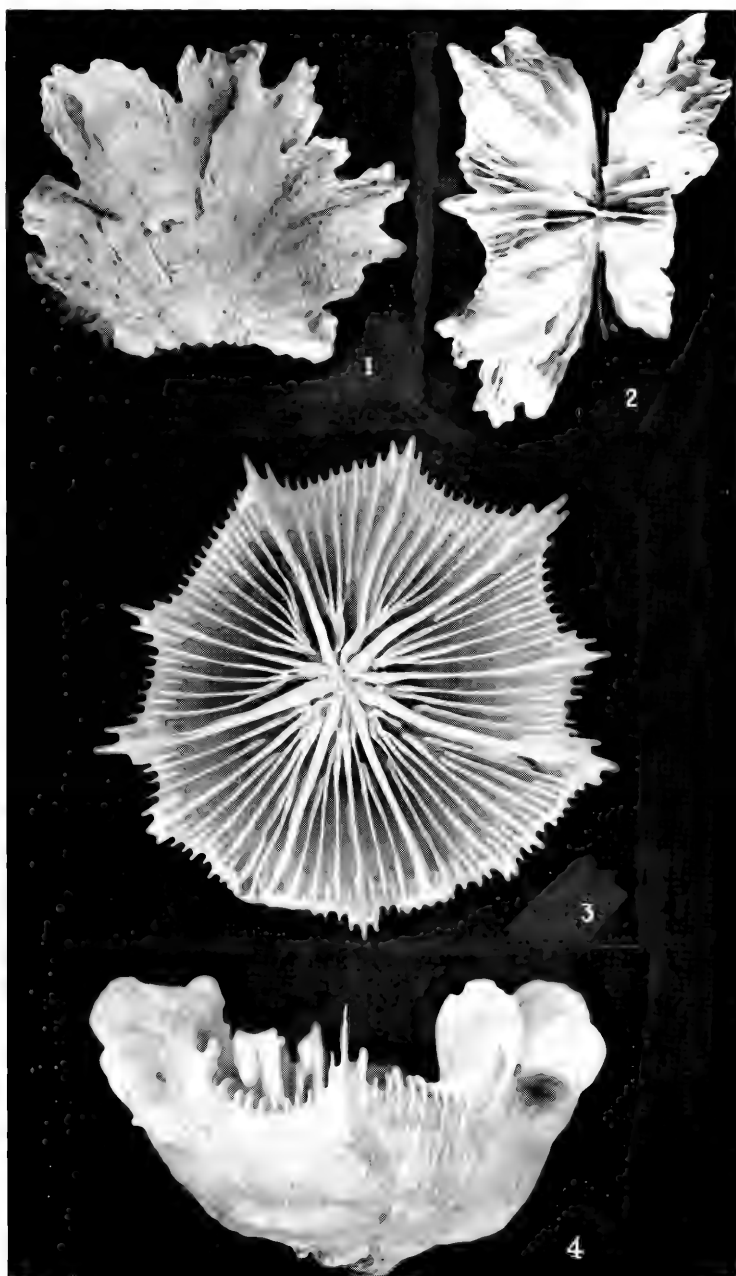
Flabellum lowekeyesi, new species

(Figs. 1, 2)

Holotype: Figured holotype deposited in the Department of Zoology, Victoria University. Paratype, U.S.N.M. 45601, U. S. National Museum.

Etymology: Specific epithet derived from the names of our colleagues, Ian W. Keyes and T. Peter Lowe.

Description: Corallum free, fragile, flabelliform, with lacerate upper margin. Corallum lateral edges forming about 180° angle, prominently crested, crest an external extension of lateral septa. Wall deeply incised immediately above lateral edge, incision including all or some of second, third and fourth septa from lateral septum. Corallum height 25.6 to 55.0 mm; maximum calice diameter 36.0 to 70.4 mm. Calice broadly open, lateral faces flaring outward from center; minimum diameter 18.0 to 30.0 mm. Corallum free, but juveniles attached to bit of shell or sand grain.



Pedicle elongate in long axis of corallum, diameter to 2.5 mm. Lateral corallum faces colorless, clean, free from attachments of other organisms. Septa projections beyond wall slight, except lateral crests. Lateral faces concave, pinched inward in central calice. Lateral faces at first form about 50° angle in central region, angle increasing progressively with corallum size. As many as 190 septa, accelerated in lateral portions of corallum. About 24 septa reach calice center, but number of septa inserted between these highly variable. First group septa slightly wavy, evenly smooth, slightly thickened at proximal margin, prominently marked laterally by growth lines more or less parallel with leading edge, and by widely dispersed granules. Higher group septa thinner, more wavy, somewhat more granular laterally. Interseptal loculae width variable.

Polyp known only from badly damaged, non-expanded specimens. Polyp cream colored, with light yellow tentacles in semi-retracted phase. Stomodeum apparently ridged but not colored.

Measurements of holotype: Height: 50 mm; maximum diameter: 55 mm; minimum diameter: 30 mm; septa number: 147.

Type-locality: Station 29, New Zealand Marine Department, 26 miles off Cape Brett, New Zealand, 732 m; 22 November 1962; 2 living specimens.

Other localities: Station 30, New Zealand Marine Department, 22 miles north of Cape Brett, 732 m; 22 November 1962; 2 living specimens. Station B683, New Zealand Oceanographic Institute, northwest of Cape Farewell, New Zealand, 40° 00' S, 171° 15' E, 378–381 m; several specimens taken alive. N.Z.O.I. Station D137, 48° 52.5' S, 169° 06' E, 640 m; several specimens taken alive.

Remarks: This species is a member of the "lacerate *Flabellum*" species group which will receive more formal designation in a pending comprehensive review. The species seems widely distributed in the New Zealand region, particularly about the Campbell Plateau where it is found in depths of 400 meters or more (unpublished data).

Other species of New Zealand *Flabellum* having a lacerate upper wall margin are *F. aotearoa* Squires, 1964, and another new species (Squires and Keyes, in press). The present species differs from *A. aotearoa* in having colorless, fluted lateral faces and is considerably larger. It differs from the undescribed New Zealand form in that it is not bowl-shaped, its wall lacks knobs or protuberances, and it is somewhat larger. Many undescribed species of *Flabellum* characterized by a lacerate upper wall margin, exist in the Philippine Islands and Coral Sea region. The present species is closely related to some of these, but differs significantly from them in its colorless wall and larger corallum size.

←

FIGS. 1, 2. *Flabellum lowekeyesi*, n. sp. Holotype XI. FIGS. 3, 4. *Stephanocyathus* sp.

FAMILY CARYOPHYLLIDAE GRAY, 1847

Genus *Stephanocyathus* Sequenza, 1864

Stephanocyathus sp.

(Figs. 3, 4)

Specimen: Deposited in the Department of Zoology, Victoria University.

Description: Corallum free, bowl-shaped, with highly exsert septa. Corallum basal portion corroded, with badly corroded remnants of stalk attachment. Corallum basal portion nearly flat, curving abruptly upward to form steep, but not vertical, wall. Septa highly exsert, upper wall margin scalloped evenly between septa. Wall costate, but costae, low and not prominent. Wall granulate, granules concentrated on summits of costae. Septa number 115 in five complete cycles with portions of sixth cycle present in most systems. Sixth cycle septa inserted on either side of fifth cycle septa in loculi adjacent to first cycle septa, and asymmetrically adjacent to second cycle septa. Columella absent, but thickened inner septa edges mingling in corallum center fill its lower portion. Corallum broadly open. Septa narrow, but rounded at upper edge, falling vertically, then becoming concave, extending towards calice center. Septa laterally ornamented with fine granules arranged along growth lines.

Polyp unknown.

Measurements: Height: 30 mm; maximum diameter: 75 mm; height of exsert septa: 12 mm.

Distribution: Station 12, New Zealand Marine Department, 15 miles N 50° E of Plate Island, New Zealand, 622–585 m; 29 September 1962, one dead specimen.

Remarks: The single specimen is large and relatively undamaged although half of the corallum was injured in life, probably through predation. Regeneration of injured portion has resulted in an asymmetrical corallum. Septal arrangement may differ slightly in normal specimens, but the arrangement described here was derived from study of undamaged sextants.

Two subgenera are recognized in *Stephanocyathus* (cf. Wells, 1956): *Stephanocyathus* and *Odontocyathus*. The former is characterized by a bowl-shaped corallum, while the latter is distinguished by the costae on the lower portion of the corallum being extended into spines. In general, specimens of *Odontocyathus* have a more cylindrical profile, and often a flat base and almost vertical walls. In many species of this group the spines may be reduced to short knobs, or in extreme cases to an expanded rim or flared lip about the base of the corallum. The present species lacks such indication of "incipient" spines, but does not have a profile which is suggestive of *Odontocyathus* in its flattened base.

Moseley (1881) described *Stephanocyathus* [S.] *platypus* from Challenger collections (Station 164) off Sydney, Australia from a depth of 750 meters. This record, the closest occurrence of the subgenus

geographically to New Zealand, is based on two specimens, neither of which is half the diameter of the present form, nor has rounded bases. Further, the tendency for the septa to join immediately before the center of the calice is not as marked, for in *S. platypus* the septa remain separate and appear slightly swollen at the proximal end. The union of septa in the New Zealand specimen may, however, be a character resulting from the age of the specimen, for the great swelling of the proximal ends of the primary septa appears to crowd those of higher cycles.

In summary, differences between the present specimen and described species of *Stephanocyathus* appear to warrant the designation of this as a new species. However, because of the questions about corallum morphology raised as a result of the size (and age?) of this specimen, it would appear more prudent to avoid naming the species at this time.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW CRAYFISH OF THE GENUS *CAMBARUS*
FROM TENNESSEE WITH AN EMENDED DEFINITION
OF THE GENUS (DECAPODA, ASTACIDAE)

BY HORTON H. HOBBS, JR.

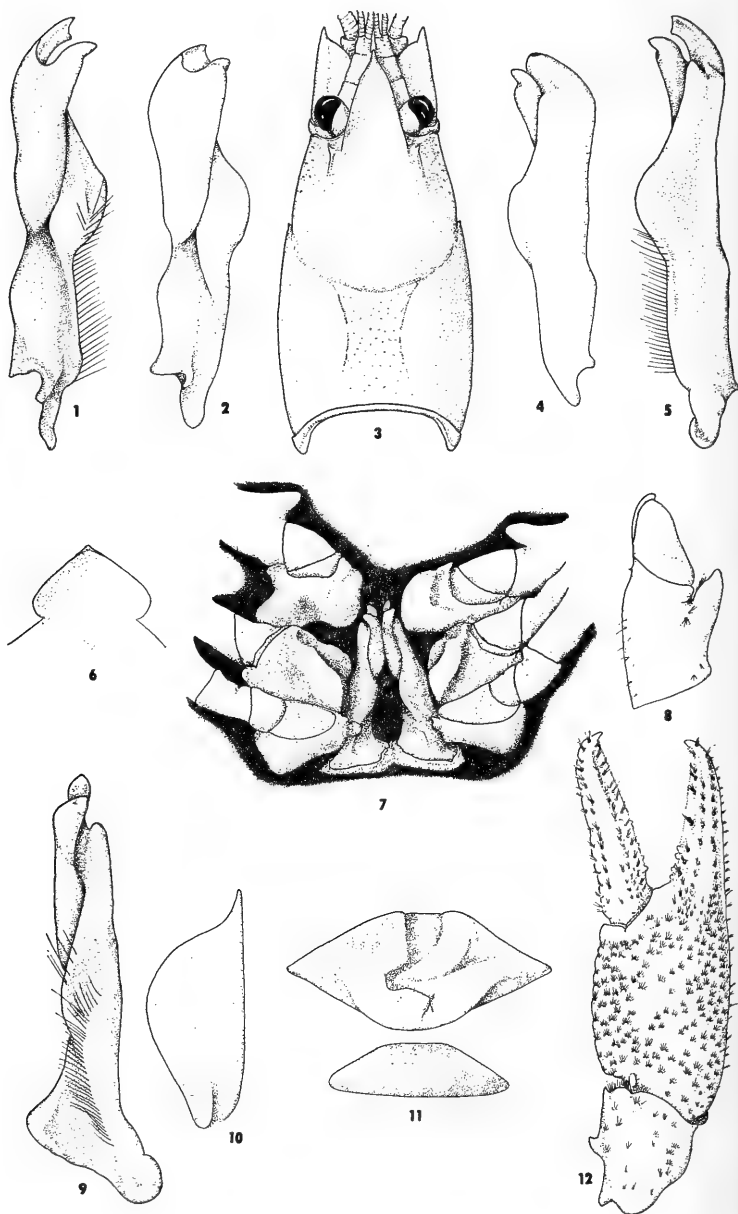
Smithsonian Institution, Washington, D. C. 20560

The species described herein first came to my attention in 1951 when John W. Parsons of the Tennessee Game and Fish Commission sent several lots of crayfishes to me that had been obtained from the watershed of the Caney Fork of the Cumberland River and Emory River. Among the specimens was a single female of a new form which had been collected from the Caney Fork proper on 4 August 1951. Attempts to secure additional specimens at that time were unsuccessful, and not until 22 July 1961, was the species seen again when Perry C. Holt obtained six specimens, including three second form males, from the Caney Fork at Pleasant Hill, Cumberland County.

With the acquisition of the males, the possible phylogenetic significance of the species became evident; however, it seemed unwise to describe it without having a first form male available.

On a collecting trip into the southeastern United States in April 1962, Joseph F. Fitzpatrick, Jr., and I obtained a series of 26 specimens, including 10 first form males.

The inclusion of this unique crayfish in the genus *Cambarus* requires a modification in the definition of the genus as proposed by Hobbs (1942:354). This definition began as follows: "First pleopod of first form male terminating in two distinct parts; both short and usually heavy and tapering to a point. Both terminal elements are bent caudad and usually at about a 90 degree angle to the main shaft of the appendage" In the new species, the pleopod terminates in three



distinct parts, the disposition of only one of which approaches a 90 degree angle to the main shaft of the appendage.

Only one other member of the genus, *Cambarus obeyensis* Hobbs and Shoup (1947: 138), possesses a pleopod approaching that of this species. In a discussion of the relationships of *C. obeyensis*, those authors stated, "The structure of the first pleopod of the male is somewhat unusual in that although all other known members of the genus have both terminal elements bent at least to a right angle from the main shaft of the appendage, in *C. obeyensis* the central projection has assumed a position somewhat intermediate between that found in the typical Cambarids and in some of the members of the Limosus Section of the genus *Orconectes*. . . ." (loc. cit., p. 141). In order adequately to accommodate these two species in the generic diagnosis, the following is proposed.

GENUS *CAMBARUS* ERICHSON 1846: 88

Diagnosis: First pleopod of first form male symmetrical and terminating in two or three distinct parts, usually only two (mesial process and central projection) bent caudally or caudolaterally with principal axes of shaft and each ramus forming angles of approximately 90 degrees; if mesial process and central projection directed at angles of less than 90 degrees to main shaft, central projection never comprising more than $\frac{1}{8}$ of total length of appendage or bent at angle of less than 45 degrees; central projection corneous and flattened laterally; mesial process mostly non-corneous, frequently inflated; caudal process, when present, forming knob-like prominence at caudolateral base of central projection. Hooks present on ischiopodites of third pereopods only except in *Cambarus dissitus* Penn (1955: 73) in which also present on those of fourth pereopods. Opposable margins of ischiopodites of third maxillipeds with teeth.

←

PLATE I. *Cambarus pristinus*, sp. nov. 1, Mesial view of first pleopod of holotype; 2, Mesial view of first pleopod of morphotype; 3, Dorsal view of carapace of holotype; 4, Lateral view of first pleopod of morphotype; 5, Lateral view of first pleopod of holotype; 6, Epistome of holotype; 7, Bases of third, fourth, and fifth pereopods and first pleopods of holotype; 8, Basipodite and ischiopodite of third pereopod of holotype; 9, Caudal view of first pleopod of holotype; 10, Antennal scale of holotype; 11, Annulus ventralis of allotype; 12, Distal podomeres of cheliped of holotype.

***Cambarus pristinus*,¹ new species**

Diagnosis: Pigmented; eyes of normal size and with pigment; rostrum widest at base, margins tapering, and tip reaching slightly beyond penultimate segment of base of antennule, marginal spines or tubercles lacking; postorbital ridges not prominent but terminating cephalically in spines or acute tubercles; areola conspicuously broad (1.8–2.3 times longer than wide, with 6 to 9 shallow punctations across narrowest part); lateral surfaces of carapace provided with spine on each side; chela of first form male 2.6–2.9 times longer than greatest width, dorsal surface studded with squamous setiferous tubercles. Simple hooks present on ischiopodites of third pereopods only. First pleopod of first form male reaching base of third pereopod when abdomen is flexed and terminating in three parts; mesial process thumblike, non-corneous, and directed caudolaterally at angle of 80 to 85 degrees to main shaft of appendage; central projection blade-like, concave distally, corneous, and directed caudolaterally at angle of approximately 50 degrees to main shaft; caudal element knoblike, non-corneous, and situated at caudolateral base of central projection. Annulus ventralis as figured (Fig. 10).

Holotype male, Form I: Pigmented, eyes normal. Body subcylindrical. Abdomen narrower than thorax (11.4 and 12.5 mm in widest parts, respectively). Carapace wider than deep in region of caudodorsal margin of cervical groove (12.3 and 10.0 mm); carapace widest slightly cephalic to midlength of areola.

Areola (Fig. 3) broad, 2.14 times longer than wide, with 7 or 8 punctations across narrowest part. Cephalic section of carapace 2.1 times longer than areola; length of areola 31.9 percent of entire length of carapace. Rostrum with non-thickened, slightly elevated convergent margins continuing uninterrupted almost to apex; long acumen not distinctly delimited at base, terminating apically in corneous upturned tubercle reaching slightly beyond base of distal podomere of peduncle of antennule; upper surface plane apically and slightly concave caudally with shallow fovea at base and with scattered punctations; row of setiferous punctations mesial and lateral to elevated margins, lateral row terminating cephalically at base of acumen, mesial row continuing onto acumen. Subrostral ridges poorly developed and evident in dorsal aspect for only short distance at base of rostrum. Postorbital ridges moderately well developed, each with shallow, setiferous, dorsolateral groove and terminating cephalically in corneous spiniform tubercle. Suborbital angle well defined and acute. Branchiostegal spine moderately well developed and acute. Surface of carapace punctate dorsally and granulate laterally, prominent *cervical spine* (name here proposed to replace *lateral spine*²) present on lateral surface just posterior to cervical groove.

¹ *Pristinus*, L.—early, primitive; so named because of the assumed primitive characters possessed by this species.

² The designation, "lateral spine," has been used carelessly in the past to apply to the cervical spine and the marginal spine of the rostrum, and in some species (viz. *O. limosus*, *O. pellucidus*) to the many spines on the lateral surface of the

Abdomen longer than carapace (27.5 and 23.5 mm). Cephalic section of telson with two spines in each caudolateral corner.

Epistome (Fig. 6) broader than long, broadly rounded with short cephalomedian projection. Antennule of usual form with spine on lower surface of basal segment slightly distal to midlength. Antennae broken but probably extending caudad to second or third abdominal segment. Antennal scale (Fig. 11) 2.4 times longer than broad with greatest width slightly distal to midlength; mesial margin of lamellar portion evenly rounded; outer heavier portion terminating in strong spine.

Right chela (Fig. 12) elongate, subovate in cross section, and with palm only slightly inflated; palm studded with squamous, setiferous tubercles extending along upper and lower proximolateral surfaces of immovable finger; inner margin of palm with row of 10 tubercles, other slightly smaller ones irregularly arranged dorsolateral to this row; dorsal proximal articular tubercle conspicuous and more elevated distally than in most crayfishes; upper articular tubercle at base of dactyl not so conspicuous. Opposable margin of immovable finger with 4 tubercles along basal third, with crowded denticles along distal two-thirds; upper surface with median longitudinal ridge flanked by deep setiferous punctations; lateral margin costate with single row of similar punctations; lower surface similar to upper one but punctations lateral to ridge much shallower. Opposable margin of dactyl with row of 4 tubercles along proximal half and crowded denticles along distal half; upper and lower surfaces similar to those of immovable finger; mesial surface with row of squamous, setiferous tubercles becoming progressively smaller and more adpressed distally.

Carpus distinctly longer than broad (5.8 and 3.2 mm) with shallow oblique furrow on upper surface; upper surface mostly punctate but with few squamous tubercles and prominent spiniform tubercle on mesiodistal margin; mesial surface punctate proximally and tuberculate distally with very large tubercle near distal margin; lower surface with only two prominent tubercles, distolateral spiniform one and broad submedian distal one.

Dorsal surface of merus with a single anteapical acute tubercle; lateral and mesial surfaces with widely scattered tubercles; laterodistal and mesiodistal articular knobs with corneous acute tubercles; lower surface with mesial row of 8 tubercles and lateral one of 4, tubercles in both rows progressively more spiniform distally. Ischium with ventral margin irregular and with one very small tubercle; otherwise punctate.

Hooks (Figs. 7, 8) on ischia of third pereopods only; hooks simple and projecting proximally beyond distal margin of basis. Caudomesial surfaces of coxae of fourth pereopods (Fig. 7) with unusually prominent tuberosities bearing densely setiferous excavations cephalomesially.

carapace not in the cervical cluster. This proposal should result in a more exact and less ambiguous terminology.

First pleopods (Figs. 1, 5, 7, 9) symmetrical and extending cephalad to coxae of third pereopods when abdomen is flexed. See diagnosis for description.

Allotypic female: Excluding secondary sexual characters, differing from holotype in following respects: most tubercles more acute and most spines longer; opposable margin of dactyl with 5 tubercles in proximal half and another at proximal end of distal two-fifths of finger; opposable margin of immovable finger also with 6 tubercles, the distalmost slightly more distal than corresponding tubercle on dactyl; opposable margins of both fingers with single row of minute denticles between and distal to tubercles; mesiodistal articular knob of merus with spine or tubercle, lower surface with mesial row of 10 and lateral one of 5 tubercles.

Annulus ventralis (Fig. 10) slightly movable, more than twice as broad as long; cephalomedian trough, flanked by longitudinal ridges, narrowing near midlength with caudal portion directed caudodextrally and joining cephalic arm of tilted S-shaped sinus; cephalic curve of sinus extending caudodextrally and caudal one directed cephalosinistrally with slightly more than cephalic half of sinus lying dextral to median line and slightly more than caudal half situated in caudal half of annulus; caudal third of annulus produced caudally into broad, rounded, ventrally flattened lobe. Sternal sclerite immediately caudal to annulus more than three times broader than long. (See *Measurements*).

Morphotypic male, Form II: Differs from holotype in following respects: spines and tubercles more nearly like those in allotype in size and shape; opposable margin of dactyl with 3 tubercles in proximal one-fourth of finger and an additional one situated somewhat lower than three just mentioned immediately proximal to midlength of finger; opposable margin of immovable finger similar to that of dactyl but with 4 tubercles in proximal group; mesiodistal articular knob of merus without spine or tubercle, lower surface with mesial row of 5 tubercles; only 2 in position of lateral row in holotype and allotype; hook on ischiopodite of third pereopod strong and reaching level of distal end of basipodite; prominence on coxopodite of fourth pereopod only slightly less well developed than in holotype. (See *Measurements*).

First pleopod (Figs. 2, 4) with all three elements reduced and central projection non-corneous; all disposed approximately as in holotype.

Measurements: As follows (in millimeters):

| | Holotype | Allotype | Morphotype |
|----------|----------|----------|------------|
| Carapace | | | |
| Height | 10.0 | 13.2 | 11.3 |
| Width | 12.5 | 16.0 | 13.4 |
| Length | 23.5 | 32.3 | 29.4 |
| Rostrum | | | |
| Width | 3.9 | 5.4 | 4.4 |
| Length | 6.7 | 8.2 | 8.3 |

| | Holotype | Allotype | Morphotype |
|---------------------------|----------|----------|------------|
| Areola | | | |
| Width | 3.5 | 5.2 | 4.2 |
| Length | 7.5 | 11.0 | 9.7 |
| Chela | | | |
| Length, palm inner margin | 7.0 | 8.7 | 8.3 |
| Palm width | 6.4 | 8.7 | 7.4 |
| Length, hand outer margin | 17.3 | 22.7 | 21.6 |
| Dactyl length | 9.4 | 10.8 | 10.2 |

Type-locality: White Oak Creek, a tributary to the Caney Fork of the Cumberland River, 3.9 miles east of the White-Cumberland County line and 0.1 miles south of U. S. Rte. 70S. Here the creek, some 10 to 15 feet wide and 8 to 10 inches deep, is clear and flows with a moderate current over a bed-rock exposure with scattered stones and small gravel deposits. The stream flows through a wooded area with *Quercus* sp., *Acer* sp., and *Kalmia latifolia*. *Cambarus pristinus* shares this stream with two unidentified species of the same genus.

Disposition of types: The holotypic male, form I (no. 115528), the allotypic female (no. 115529), and the morphotypic male, form II (no. 115530) are deposited in the United States National Museum as are the following paratypes: 8 males, form I; 1 male, form II; 16 females; 3 juvenile males; and 1 juvenile female. Paratypes consisting of one male, form I, one female, and one male, form II, are deposited in the Museum of Comparative Zoology.

Range: *Cambarus pristinus* is known from only three localities, all in the drainage of the Caney Fork of the Cumberland River in Cumberland County, Tennessee: the type locality; Caney Fork River just east of Pleasant Hill on U. S. Rte. 70S; and Caney Fork River at Ridgedale bridge, one mile northeast of Clifty. Although extensive collections are not available from this area, it is surprising that among the localities represented *C. pristinus* has not been encountered more often; perhaps its range is as restricted as it seems.

Life history notes: First form males were collected on 19 April 1962, and 7 of the 14 females obtained the same day were carrying eggs.

Relationships: *Cambarus pristinus* has its closest affinities with *Cambarus obeyensis* Hobbs and Shoup which is also an inhabitant of the Cumberland River drainage system. The latter appears to be confined to the headwaters of the East Fork of the Obey River in Cumberland, Fentress, Putnam, and Overton counties, and it is probable that *C. pristinus* is restricted to the Caney Fork. Although the two share a number of features in common, the broad areola, the caudal process on the first pleopod of the male, and the caudomedian prominence of the annulus ventralis of *C. pristinus* distinguish it from *C. obeyensis*, and the presence of a caudal process is unique among members of the genus.

Discussion: *Cambarus pristinus* possesses several characteristics which

are considered to be among the most primitive of the genus. Most prominent among them is the very broad areola which is approximated by only one other species of the genus, *Cambarus extraneus* Hagen (1870:73). Less conspicuous, but perhaps of greater value in assessing relationships, are the number and arrangement of the terminal elements of the first pleopod. In addition to the two elements that are always present in *Cambarus*, there is also a very prominent caudal knob, rudiments of which are evident in a number of species of the genus. The arrangement of the other two elements is as similar to that in many species of *Procambarus*, *Cambarellus*, and *Orconectes* as to that of other members of the genus *Cambarus*. The chelae are unique among epigean *Cambarus* and resemble those of members of the genus *Procambarus* far more closely than they do those of most members of *Cambarus*.

It does not seem to be a coincidence that these primitive characteristics are encountered in a crayfish inhabiting a stream on the Cumberland Plateau, for as is discussed elsewhere (Hobbs and Barr, in a manuscript submitted for publication) in somewhat greater detail, this area is postulated to have been inhabited by a stock of crayfish that was near the stem-form of both *Orconectes* and *Cambarus*. The extant forms that are believed to have preserved most characteristics of this ancestor are the troglobitic members of the genus *Orconectes* frequenting subterranean waters of the same region. In *Cambarus pristinus*, the postulated primitive features of the first pleopod are as well preserved and only slightly more modified than they are in these troglobitic animals; the caudal knob is even more prominent than it is in them. If our postulates that have been proposed in attempting to reconstruct the origin of the troglobitic *Orconectes* prove tenable, then it is appropriate that the primitive *Cambarus pristinus*, living in the ancestral home, should be considered a relict of the ancestral pro-*Cambarus*-*Orconectes* stock. A greater number of primitive features is preserved in *C. pristinus* than in any other member of the genus.

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PROCEEDINGS
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THE BOTANICAL ACTIVITIES OF PAUL BARTSCH
(1871-1960)

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For many years, the flora of the District of Columbia and vicinity has been a continuing interest of various botanists in the U. S. National Museum. As a result, a separate "District Herbarium" has been maintained which has served as the reference point for all studies of the local flora and vegetation. A. S. Hitchcock and P. C. Standley based their 1919 *Flora of the District of Columbia and Vicinity* on this herbarium. In a more recent cycle of floristic activity, begun in the 1940's and stimulated in large part by Egbert H. Walker, then a curator in the U. S. National Herbarium to which the District Herbarium belongs, the collection was expanded to serve as the basis of *A Checklist of Plants in the Washington-Baltimore Area*, by F. J. Hermann (ed. 2, 1946).

Since assuming curatorial responsibility for the District Herbarium several years ago, the junior author has tried to encourage additions to it. In 1962, Dr. Elizabeth Parker Bartsch, widow of the late Dr. Paul Bartsch, kindly donated Dr. Bartsch's personal herbarium to the Smithsonian Institution. The collection numbered approximately 5,000 specimens, and most of these had come from areas around Washington,

¹ The senior author collaborated in this research while she was an Undergraduate Research Participant in the 1965 Smithsonian Summer Education Program. Her appointment was financed by a grant to the Smithsonian Institution from the National Science Foundation. The grant was administered by I. E. Wallen, Assistant Director for Oceanography, U. S. National Museum, Smithsonian Institution, Washington, D.C. 20560, and the appointment was sponsored by the Museum's Department of Botany, W. L. Stern, Chairman.

D.C. This represented the most significant addition to the District Herbarium in recent years. It was all the more significant because most of the collecting had been done shortly after the turn of the century before so many of the once-fascinating natural areas around Washington had given way to concrete and steel.

The present collaboration with the senior author, who has carried the main burden of sorting, labeling, and identifying these specimens, has finally made it possible to prepare the Bartsch Herbarium for permanent preservation in the District Herbarium and to distribute some of the duplicates. This paper, based on Bartsch's collection, on available literature and records, and on personal recollections of those who knew and worked with him, discusses briefly his plant collecting activities stretching over more than half a century. Bartsch's collections are also evaluated for their overall significance, and an annotated list of his major collecting localities is appended. This information, we hope, will contribute to our historical knowledge of floristic activities in the Washington area.

Paul Bartsch was a world-renowned malacologist who for 32 years (1914–1946) was Curator of the Division of Mollusks, U. S. National Museum. He was also something of a celebrity and legend in the Washington area for his civic-minded role, as a sort of naturalist-at-large, in the public life of the city. A naturalist of the old school, Bartsch seemed to know everything that grew or crawled and often wandered far afield from his principal specialty in the course of his numerous explorations and researches. During his boyhood days in Germany (1871–1882), he developed an avid interest in birds, and later, after his family had emigrated to Iowa, he pursued the study of ornithology, writing the "Birds of Iowa" for his master's thesis (1899). He never really abandoned ornithology, and published many significant papers on birds during his lifetime. His efforts at scientific bird-banding in 1902 are said to be the first attempts in North America since the abortive attempts of John James Audubon. It was Bartsch's doctoral research on the zoogeography of the East Pacific Pyramidellidae, completed over a period of nine years at the National Museum, which finally turned his prime attention from birds to mollusks. This won him a Ph.D. in absentia from the State University of Iowa (1905), where previously he had earned his bachelor's and master's degrees, the latter also in absentia. Even after this, ornithology, of all his pursuits, seems to have remained the closest to his heart throughout his life.

Whatever his pursuit, Bartsch was a tireless collector and writer. Barnes (1953, p. 128) put it well when he wrote:

Field explorations were a part of his daily life, and they did not need to involve mollusks and marine biology: the goal might be spring migrants, ferns of the Blue Ridge, the plant and animal life of the Dismal Swamp, or almost any living laboratory exhibiting natural laws at work.

His extensive expeditionary work took him to virtually every island in the West Indies and on one long, particularly memorable trip to the Philippines (1907-08). He went there while serving as Smithsonian naturalist aboard the *Albatross*, a vessel of the U. S. Bureau of Fisheries, celebrated for its many voyages of exploration. This was Bartsch's only expedition to the Pacific Islands. Altogether, Bartsch published more than 450 scientific papers during his life, mostly on birds and mollusks. He also wrote many popular articles on natural history.

Among Bartsch's lesser known pursuits was his life-long interest in plants. As a college freshman at the State University of Iowa, he prepared a paleobotanical report for the U. S. Geological Survey, under the direction of Professor Thomas H. Macbride, who later became President of the University. This report resulted in what can be regarded as his first scientific paper, "Notes on the Cretaceous Flora of Western Iowa."² His few previous articles were little more than popular notes on bird-watching. Ironically, this was his first and last scientific paper on botany, although he later wrote botanically slanted popular articles and often mentioned plants in papers concerned primarily with zoological subjects, as in his paper, "A Trip to the Dismal Swamp" (*The Osprey* 5: 12-19. 1901).

Bartsch began to collect plants and build up a personal herbarium while he was still an undergraduate student in Iowa City. He collected widely in Iowa, reaching into Allamakee, Clayton, Davis, Des Moines, Dubuque, Jackson, Johnson, Lee, Muscatine, Scott, Winneshiek, and probably other counties. Many of these first collections were carefully identified and labeled with printed labels, and some specimens were even mounted. The Iowa collecting was all done in 1895. The next year he moved to Washington, D.C., to accept a position at the National Museum, and he was instantly fascinated by the different plants of the Piedmont and Coastal Plain, beginning at once to collect. His

² Bulletin from the Laboratories of Natural History of the State University of Iowa 3 (4): 178-182. 1896. Dr. Harold A. Rehder, U. S. National Museum, who has access to Bartsch's own card file of all Bartsch's publications, makes this interesting comment about Bartsch's paleobotanical publication: "The story that he published a paper on the 'Fossil Flora of the Sioux Quartzite' in 1896 is one that has appeared in print several times [e.g., Barnes 1952, p. 219], but it appears to be without foundation although Bartsch believed it to be a fact, at least in his later years, for this statement appears in unpublished memoirs. The Sioux Quartzite is a Pre-Cambrian formation that is highly metamorphosed." [Only a few primitive fossil plants have been documented from Pre-Cambrian rocks in recent years.]

subsequent botanical collecting was confined largely to the District area despite his many long expeditions to faraway places. The largest plant collection he made on any of these expeditions was made in connection with the *Albatross* voyage when he brought back about 1,100 specimens (Nos. 1-542), with duplicates. The great majority of these (Nos. 112-169, 208-542) came from the Philippine Islands, and most of them were ferns, especially tree ferns. This Philippine collection made an important addition to the fern herbarium of the U. S. National Herbarium. Small collections, again mostly ferns, were also made on the Hawaiian Islands (Nos. 1-88), Midway Island (Nos. 89-96), Guam (Nos. 97-111), and North Borneo (Nos. 170-207). On occasion one to several specimens were brought back from his West Indian travels, but his plant collecting in the Caribbean region was trivial, confined essentially to bringing back a few live cacti now and then for J. N. Rose to culture in the National Herbarium greenhouse. Altogether, scarcely more than a dozen plants, collected by him in the Bahama Islands, Cuba, and Martinique, have been accessioned and preserved in the National Herbarium over the years.

Bartsch's expeditionary collections were always placed in the Division of Plants (now Department of Botany) at the Museum promptly after he returned from the field, but Bartsch presented very few of his District area and other United States collections to the Museum during his lifetime. The accession records in the Department of Botany and the annual reports of the U. S. National Museum show a trickle of gifts of 1-20 specimens at a time from the District of Columbia, Virginia, North Carolina, Indiana, Illinois, and Iowa, during only a few of his many years at the Museum. However, he was collecting hundreds of specimens locally during that time. Undoubtedly, most of these local plants were collected on his personal time, unlike the expeditionary collections, and he probably regarded his local plants as personal property. Still, this is hardly an adequate explanation. Perhaps he harbored a certain natural jealousy for his local herbarium because of its special value at the time and entertained hope of some day doing serious scientific work on these plants. At the turn of the century when he was most active in his plant collecting, serious students of the local flora had only the much outdated *Guide to the Flora of Washington and Vicinity*, by L. F. Ward (1881), and a number of supplements (see our bibliography) for botanizing. The *Guide* lacked keys and left much to be desired as a manual. New additions to the known list of local species were being made regularly by various other collectors, and Bartsch may have been competing in the friendly race, perhaps even having ambitions of revising Ward's *Guide*. In any event, the majority of his local collections were made between 1896 and 1917, but primarily during the first 10 years of this period and again in 1917, and this entire period was prior to the year (1919) when the new *Flora* by Hitchcock and Standley appeared. The significance of this observation is discussed below.

During his early years at the Smithsonian, Bartsch's intensive in-

terest in both the local flora and fauna was well known, and he was given the chief responsibility for the creation of the so-called "District Rooms" in the new Museum of Natural History, opened in 1911. The idea had been largely his. The rooms contained public displays of local birds, animals, and plants. It was characteristic of Bartsch that he did not consult anyone in the Division of Plants concerning the plant display. This exhibit was retained long after it was outmoded and was finally dismantled in the 1950's. The last of these local exhibits, the much antiquated bird exhibit, remained in place until early 1965.

Outside the immediate environs of Washington, Bartsch took a special interest in the plants of Dismal Swamp and the Blue Ridge Mountains, both in outstate Virginia, and his herbarium, as it came to the Smithsonian, included upwards of a thousand specimens, principally ferns, from these two regions but especially the Blue Ridge. During some years, summer vacations were spent in the Blue Ridge near the town of Paris, and this fact may account for his Blue Ridge interest. Many mosses were also collected here. He personally concentrated on ferns all his life, as witness also his Philippine and later his "Lebanon" (see below) activities, and he encouraged his first wife to take a special interest in mosses. She was the principal if not the sole collector of his several hundred moss specimens. In addition to his Blue Ridge and Dismal Swamp efforts, token collections were made elsewhere beyond the local area. In Maryland, sizable collections of vascular plants were made around Annapolis. Small fern and lycopod collections from Alabama (1907), Minnesota (1907), Tennessee (1907), Wisconsin (1907), Maine (1910, 1914), and New York (1916)—to name the most obvious—were among his herbarium specimens. The remaining Iowa collections, made in 1895 from localities already mentioned, numbered several hundred. Finally, on a trip to Sweden in 1908, Bartsch, fascinated by the boreal and subarctic flora around Falun, collected a token herbarium.

Returning to his local activities, we find that favorite collecting areas were: Beltsville Bog, Benning, Falls Church, Four-Mile Run, Burnt Mills, South River, Patuxent River, Rock Creek, Great Falls, Chain Bridge, Receiving Reservoir, Aqueduct Bridge, High Island, Potomac Flats—the Potomac River region in general—and Congress Heights (see appended list). Local transportation then was mostly by trolley or train, and his stations tended to be along the various track lines that radiated out of the city. Bartsch took credit, at least implicitly, for nearly all of his herbarium. A few 1917 collections are credited to his son Henry, and a few specimens bear the names of others, such as the specimens labeled "*Ex Herb. F. L. J. Boettcher.*" Since he is known to have collected in the company of students and colleagues, it must be assumed that he often had help. The case of the mosses has already been mentioned, and it seems likely that he may have absorbed the collections of still others into his herbarium. In particular, there is a high likelihood that some of the plants of the avid local collector Julius Ulke were appropriated by Bartsch.

Although Bartsch moved to Washington in 1896 to take up research on mollusks at the U. S. National Museum, as assistant to William H. Dall, then Curator of the Division of Mollusks, he soon became involved in college teaching in the city. In 1899, he began teaching animal histology in the medical school of Howard University, continuing for 37 years, and a year later became an instructor in zoology at George Washington University, where, before long, he introduced coursework in botany. Later (1912) he was responsible for initiating a graduate program in the natural sciences at George Washington. He taught zoology here until 1945 but gave up teaching botany relatively early. His ornithology classes are well remembered for their stimulating early morning bird walks, when Prof. Bartsch was as likely to call attention to a spring flower or salamander as to a bird. He occasionally also took his students on long field trips to the Eastern Shore. Even before his formal teaching career began, he had been asked by a prominent local attorney and amateur naturalist, a Mr. Doubleday, to take over a biology class the latter had organized for the young people of the city. This class promptly became known as the "Bartsch Botanical Club." Barnes (1952, p. 223) features a picture of this club on one of its outings in 1898.

Bartsch's enthusiastic immersion in teaching during those early years surely was responsible in part for stimulating his serious botanical activities. Judging by the large number of duplicates among his collections, it seems very likely that his students on those bird walks and his "Club" members or similar groups assisted in his collecting of plants. Friends do not recall that he was one to carry a collecting vasculum and suggest that he probably relied on student assistants many times. At any rate, his herbarium bore signs of having been used pedagogically at times, because some miscellaneous teaching notes, pitched to a rather amateur level, were found scattered among the specimens.

His plant collecting seems to have stopped abruptly in 1917. It was resumed again in 1946, after his retirement from active curating at the Smithsonian, but this time restricted to his own estate, "Lebanon," at Lorton, Virginia. This long interruption was probably due to the press of official duties and research which were relieved at retirement. At the same time, he undoubtedly lost considerable interest in the local flora after the appearance of the up-to-date and seemingly definitive 1919 *Flora of the District of Columbia*.

The purchase of "Lebanon" in 1942, a 458-acre estate on Pohick Bay along the Potomac River some 25 miles south of Washington, opened the second and final phase in Bartsch's botanical activities. This very old estate had a rich and diversified native flora, including a number of uncommon plants such as mistletoe (*Phoradendron flavescens* [Pursh] Nutt.), adder's-tongue fern (*Ophioglossum vulgatum* L.), and a variety of orchids. After Bartsch retired to Lebanon in 1946, he, constantly aided by his second wife, Dr. Parker, devoted much time during his remaining

years to developing the wildflower gardens and wildlife sanctuary that they had begun to create in 1942. Bartsch's experience with native flower gardening dated back to his place on Belmont Avenue in Washington, where over the years he had built up a remarkable collection of native ferns, orchids, bog plants, and many other kinds, hauling in appropriate soils and constructing artificial bogs and fern pits. At Lebanon, he tried to do on a grand scale what he had done in miniature at Belmont. Together, the Bartsches took many field trips throughout the eastern states, ranging from the Gaspé Peninsula, Québec, to the Florida Peninsula and from the Atlantic Coast to the Mississippi Delta, to collect specialties for their wildflower gardens. Primarily, the quest was for living plants and few if any herbarium specimens were prepared on these trips. His last herbarium collections were made on the Lebanon acres in 1946 with the aim, presumably, of documenting the complete native flora on the estate. Considering his extensive efforts at introducing exotic species, first to Belmont and later to Lebanon, caution must be exercised in evaluating unusual records from these areas as well as from his herbarium.

Bartsch was clearly knowledgeable about native species because he tried systematically to build up complete living collections of various plant groups and searched out botanically interesting endemic species. Three trips were made to the mountains of North Carolina before he finally succeeded in locating a population of the rare Piedmont-Blue Ridge endemic, *Shortia galacifolia* T. & G. He had a natural bog on his estate and created others, taking special interest in transplanting bog plants such as Venus flytrap, sundews, and virtually all species of the pitcher-plant genus *Sarracenia*. He and his wife created a special fern garden in a natural ravine on the premises, which became known locally as "Fern Valley." According to Barnes (1954), he successfully grew "all" eastern American species and some exotic ferns from Iceland and England in this Valley. Some of the more interesting species were: *Polypodium polypodioides* (L.) Watt (from Louisiana), *Polystichum braunii* (Spenner) Fée (from Vermont), *Schizaea pusilla* Pursh (from New Jersey pine barrens), and *Woodsia ilvensis* (L.) R. Br. (from Gaspé). His fern interest was reflected in his herbarium by the very disproportionate number of fern specimens, as already hinted. Altogether, the list of exotic species introduced to Lebanon, whether ferns or flowering plants, is impressive. We should add that many of these species were transplanted from Belmont, and the record is not too clear on when all the plant-hunting excursions were made.

The activities of the Bartsches on their estate at Lorton attracted wide local attention, and many scout and other youth and adult groups made regular pilgrimages to Lebanon to see the gardens and wildlife. The Audubon Naturalist Society and the Botanical Society of Washington, in which Bartsch took a nominal interest through the years, held annual picnics at Lebanon for a time after 1946. His widow still resides there.

The Bartsch Herbarium was in a rather poor state of preservation when it came to the Smithsonian. It had been kept in the basement of his home and had suffered great damage from water, rodents, insects, and fungi, even though the specimens had been stored in standard metal herbarium boxes ("Cambridge" boxes). At first there was serious question whether anything could be salvaged and in the end only about 1,000 specimens of the original 5,000 have proved sufficiently well preserved and documented to warrant being saved. While this represents a drastically reduced segment of his original herbarium, it nevertheless still represents a very substantial addition to the U. S. National Herbarium and especially to the District Herbarium.

The specimens in the Bartsch Herbarium were nearly all unmounted and kept on single or between folded sheets of news stock. The vast majority were unnamed and those that were named had to be verified, because his specific determinations were not very reliable. Only a minority of the collection had standard herbarium labels, most of which had deteriorated seriously, and it was necessary to prepare permanent labels for nearly all of the 1,000 specimens salvaged. Apparently, Bartsch was somewhat more methodical about his plant collecting during the first few years of his activity and again in 1946, at which times he wrote the data on standard, printed labels. During most of his collecting years, however, the data were written on the pressing papers themselves or on temporary tags. On the whole, he recorded essential data, though nothing more, but we have had to discard a fair number of his collections for lack of data. In 1946, he numbered his Lebanon collections in pencil, and these numbers have dubious value. Previous local collections were not numbered, although his Iowa and expedition collections, as from the Philippines, were usually numbered. However, he had the habit of starting a new series from the number "1" each time he went on a new expedition.

It is hard to see how the bulk of Bartsch's herbarium, being unnamed and poorly labeled, could have been of any practical use to him. Moreover, the collection as a whole had no apparent organization that would have made quick access possible. Some specimens were grouped by species, genus, or family, and others by collecting locality. Just why Bartsch named so few of his plants is also hard to explain since he was reputed to know the local flora quite well. Perhaps he knew the plants so well that he didn't bother to name most of his own collections. The most likely answer seems to be that Bartsch was always and everywhere a compulsive collector whose ambitions early in his professional life also embraced plants. For the most part he knew the genera on sight and was not concerned with the species, except in special interest groups. Lacking time and incentive to study and publish on his plant collections, he was not deterred, nonetheless, from continuing to collect for many years, and the resulting herbarium grew in something less than orderly fashion. In fact, many of his specimens

seemed to have been preserved in their original pressed state, never having been examined again after collecting.

In all candor, we must report that the Bartsch Herbarium has proved less significant than we had originally anticipated. Even in the context of the times, when knowledge of the local flora was summarized by Ward's *Guide*, Bartsch's collections are not especially unusual. For the most part they represent weeds or cosmopolitan species, collected in well-known local stations even then. He made few if any truly noteworthy finds. The half-dozen or so species in his collection that were not recorded in Ward or in the appropriate supplements all belong to taxonomically difficult groups and are debatable additions to the flora as full species. In short, his collecting bears all the signs of incidental collecting—*i.e.*, collecting that one might conveniently do together with some more preoccupying mission (*e.g.*, bird-watching or bird-banding). These facts take issue with the statements of some intimates who remember him as a man with a sharp eye for unusual plants. It might be added further that he tended to collect the showy plants; grasses, for instance, are very poorly represented in his collection.

It is indeed unfortunate that Bartsch did not make his large collection available to Hitchcock and Standley when they were writing their *Flora*. At that time the specimens would still have been in a good state of preservation and could have augmented existing collections at the National Herbarium much more significantly than at present, even though, as already mentioned, they would not have contributed additional species. The great surprise is that Bartsch seemingly did not participate in their effort, which was spread widely among many local botanists, although he was already a prominent figure in the National Museum and must have known both Hitchcock and Standley very well. For their part, they could hardly have appreciated the size of Bartsch's personal herbarium even at that time, or surely they would have made some effort to see and cite it. Perhaps Bartsch felt that his intense efforts at the turn of the century gave him priority over other efforts. Maybe he even tried privately to rival the Hitchcock-Standley effort. His burst of collecting in 1917, almost on the eve of the appearance of their work, followed by his apparent loss of interest in the local flora afterward, both suggest the possibility of a race privately run and lost. In fairness, however, we must add that Standley, who wrote most of the *Flora*, always worked with the collections at hand and seldom went out of his way to borrow specimens. If Bartsch's herbarium was not easily accessible, as the case seemed to be, Standley would hardly have wasted his time trying to consult it. At any rate, Bartsch himself apparently never published a new record, nor is he credited by anyone of the time for having obtained new records (*cf.* bibliography).

Today, Bartsch's collections are valuable chiefly for the important information they add to our historical knowledge of the local flora, by

giving us a better picture of the native and introduced flora around the turn of the century when natural areas were more abundant within and around the city. Bartsch collected more than 350 species of local vascular plants, distributed in nearly 200 genera and 75 families. New localities were recorded for many species, and the size of his collection, as salvaged, makes his herbarium important for this reason alone. Withal, it must be emphasized that the Bartsch Collection constitutes a very worthwhile addition to the District Herbarium of the U. S. National Herbarium. Its importance will be realized more fully if and when a new effort is made to revise the 1919 *Flora*.

COLLECTING LOCALITIES

The main list includes all localities in the Washington-Baltimore area as defined for Hermann's *Checklist* (1946), but localities from outside the *immediate* vicinity of Washington (*cf.* Ward's map, 1881), *i.e.*, beyond a radius of 20–25 miles from the Capitol, are prefixed by an asterisk (*e.g.*, *South River, near Annapolis). Detailed locality annotations are given in this first list. In the other three lists, only the place-names are given, because Bartsch's data are still adequate for locating these collection sites, if one has reasonable maps at hand. The remaining explanation applies, therefore, only to the first list.

Bartsch's place-names are italicized and listed alphabetically. They are numbered consecutively to facilitate cross reference. If Bartsch used an incorrect or archaic spelling or more than one spelling, we adopted the correct modern spelling unless this was likely to be confusing, in which case both his spelling and the modern spelling are indicated. The state or political unit indicated by Bartsch is not given as part of the place-name except where it must be regarded as an integral part of his locality designation, because of the proximity of another political unit. Our locality annotations are based on old and recent maps of the U. S. Geological Survey and recent maps by Rand McNally and Goushá. Modern equivalents of old place-names are given when necessary, and we have indicated whether the locality belongs in the District of Columbia (D.C.), Maryland (Md.), or Virginia (Va.). The District localities are further specified as to the quadrant of the city they belong, according to standard practice within the city: Northwest (NW), Northeast (NE), Southwest (SW), and Southeast (SE). These quadrants are formed by North and South Capitol Streets, on the one hand, and East Capitol Street and the Mall, on the other hand.

In the strict sense, the City of Washington is confined to the District of Columbia, but the greater city includes surrounding parts of Maryland and Virginia. From the standpoint of the flora of the Washington area in general, it is rather academic whether one specifies the state in which Bartsch collected, especially since he himself did not always know this when he collected along the boundaries. However, for the benefit of those who may wish to study either the Virginia or the

Maryland flora, we have attempted to determine the correct state for each of his collections. Localities along the Potomac River present special problems in this respect, and it should be noted that all islands in the river belong either to Maryland or the District, as the case may be, because the Virginia state line hugs the Virginia shore of the river. In Virginia, Alexandria today constitutes an independent city, outside of county jurisdiction, but at the time when Bartsch was actively collecting, the eastern half of the present city and the whole of Arlington County together comprised the former Alexandria County. This point must be borne in mind when interpreting his collection data.

The dates given with each locality represent the years in which Bartsch collected at the locality in question.

The following abbreviations are used: D.C., Md., Va., NW, NE, SW, and SE, all explained above; Ave., Avenue; Co., County; I., Island; mi., mile; R., River; R.R., Railroad; St., Street.

Washington-Baltimore Area

1. *Agricultural Grounds*. Site of present South Building of U. S. Dept. of Agriculture, between 12th and 14th Sts., SW D.C. 1897.
2. *Anacostia*. SE D.C. Collections of 1900 from 440 Jefferson St., a street no longer shown on city maps. 1898, 1900.
3. *Aqueduct Bridge*. Former bridge over Potomac R. near site of present Key Bridge, connecting Georgetown, NW D.C., and Rosslyn, Arlington Co., Va. Collections made along old R.R. tracks south of bridge and on bluffs north of bridge on Virginia side. 1896, 1904.
4. *Asylum Farm, D.C.* Probably area east of Fox Ferry Point, which is called St. Elizabeth's Farm on some current city maps; Farm is mostly in Prince Georges Co., Md.; cf. no. 5. 1905.
5. *Asylum, Asylum for the Aged, Foxes Ferry, Md.* Formerly Home for Aged and Infirm, now District of Columbia Village, at Fox Ferry Point, east shore of Potomac R. just above Woodrow Wilson Bridge, along District-Maryland line; Village is in SW D.C., but adjoining Farm (cf. no. 4) is in Prince Georges Co. Collecting probably done throughout general region of Point, both in D.C. and Md. 1905.
6. *Aurora Heights*. Small, former community along Wilson Boulevard just southwest of Rosslyn, Arlington Co., Va.; no longer mapped. 1900, 1917.
7. **Bay Ridge*. Town just south of Annapolis, Anne Arundel Co., Md. 1896.
8. *Beltsville Bog*. One of now extinct Powder Mill Bogs near Beltsville, Prince Georges Co., Md. 1917.
9. *Benning's [Station]*. Benning, NE D.C. 1896, 1897.
10. *Black Pond*. Probably the Black Pond along the Potomac R. near mouth of Difficult Run, Fairfax Co., Va., but could have been

- the Black Pond above Great Falls, opposite Bealls I. (Trammel I.), Fairfax Co. (*cf.* McAtee 1918). 1917.
11. *Bladensburg Swamp*. Bladensburg, Prince Georges Co., Md. 1897.
 12. *Broad Water*. Wide area in Chesapeake and Ohio Canal east of Bear I., Potomac R., Montgomery Co., Md., presently called Widewater. 1897.
 13. *Burnt Mills*. On Northwest Branch of Anacostia R. at U. S. Highway 29, Montgomery Co., Md. 1913, 1917.
 14. *Cabin John Bridge*. Bridge on MacArthur Boulevard that crosses Cabin John Creek near its mouth; *cf.* no. 15. 1896.
 15. *Cabin John Run*. Cabin John Creek³ on recent maps; tributary of Potomac R., arising near Rockville and emptying near Cabin John, Montgomery Co., Md. 1896.
 16. *Cameron Run*.³ Tributary of Potomac R., which becomes Hunting Creek in its lower tidal portion along the boundary between the city of Alexandria and Fairfax Co., Va. 1897.
 17. *Chain Bridge*. Crosses Potomac R. below Little Falls and connects NW D.C. with Arlington Co., Va. Collections from bluffs north of bridge in Virginia and from river flats south of bridge in NW D.C. 1896, 1897, 1903.
 18. *Chesapeake Junction*. Station along defunct Chesapeake Beach R.R. in extreme east corner of D.C. (NE), adjacent to Seat Pleasant, Prince Georges Co., Md.; still shown on some modern maps. 1903, 1904, 1905.
 19. *Chevy Chase Lake*. Site near intersection of Connecticut Ave. and Chevy Chase Lake Drive, Montgomery Co., Md.; all filled in at present except for small pond. Collections from 0.5 mi. east of lake. 1905.
 20. **Colonial Beach*. Town along lower Potomac R., Westmoreland Co., Va. 1899.
 21. *Conduit Road GN.-Cabin John*. Conduit Road from Georgetown to Cabin John, NW D.C. and Montgomery Co., Md.; modern name for road is MacArthur Boulevard. 1896.
 22. *Conduit Road N. C. John*. Conduit Road north of Cabin John, Montgomery Co., Md.; *cf.* no. 21. 1896.
 23. *Congress Heights*. Vicinity of intersection of Nichols Ave. and Alabama Ave., SE D.C. Some collections made along Baltimore and Ohio R.R. tracks between Anacostia and Congress Heights, SE-SW D.C. 1899, 1900.
 24. *Coral*. Presumably near Wiehle and perhaps also a station on former Washington and Old Dominion R.R., but not shown on old maps; *cf.* nos. 25, 65. Collections from Mrs. Hough's Farm. 1905.
 25. *Coral-Wiehle*. This may have been a stretch along now defunct

³ "In local usage the tidal portion of tributaries of the Potomac below Washington is typically called the creek, while the upper portion is called the run: Thus, Hunting Creek, Cameron Run, Occoquan Creek, Bull Run. Variations in this practice occur [*e.g.*, Roaches Run, which is a tidal creek], especially near Washington" (McAtee 1918, p. 111).

- Washington and Old Dominion R.R. which passed through Wiehle; *cf.* nos. 24, 65. 1905.
26. *Difficult Run*. Tributary of Potomac R., emptying south of Bear I., Fairfax Co., Va. 1897, 1904, 1905.
 27. *Eastern Branch*. Eastern Branch of Potomac R., now called Anacostia R. On older maps like Ward's (1881), used by Bartsch, E. Branch also included what was later called Northeast Branch and Indian Creek, which arises in northern Prince Georges Co., Md., near Muirkirk. Collections in 1896 could have come from anywhere between Muirkirk and the mouth of the river at Hains Point, SW D.C. Collections in 1897 came from near Reform School, now National Training School for Boys, NE D.C., and were probably collected in marshy areas along river near present Kenilworth Aquatic Gardens; some could have come from adjacent Prince Georges Co., Md. 1896, 1897.
 28. *Edmonston Ferry*. According to Bartsch's data, 5 mi. above Great Falls on the Potomac R., Fairfax Co., Va.; not located on available maps. 1904, 1917.
 29. *Falls Church*. Independent City with Fairfax Co., Va. 1896, 1897, 1898, 1903.
 30. *First Reservoir, Md.* Probably Receiving Reservoir, *cf.* no. 50. 1892.
 31. *Fort Myer*. Military Reserve, surrounding Arlington National Cemetery, Arlington Co., Va. 1896.
 32. *Four-Mile Run*. Stream forming dividing line between Arlington Co. and city of Alexandria, Va., which empties into Potomac R. just below present Washington National Airport. 1896, 1897, 1898, 1911, 1917.
 33. *Great Falls*. The Great Falls of the Potomac R. above Washington. Collections from Maryland side, Montgomery Co.: 1896; from Virginia side, Fairfax Co.: 1897, 1900, 1903, 1905, 1906, 1907, 1910, 1914.
 34. *High Island*. Island in Potomac R. just above District line in Montgomery Co., Md., although sometimes said to be in D.C. 1896, 1897.
 35. *Jackson City*. Former Jackson City Station, referred to by Ward (1881) as Jackson City, near present 14th St. bridges, Arlington Co., Va. 1896, 1897.
 36. *Jackson Island*. Island in Potomac R., Montgomery Co., Md.; also shown on some maps (*cf.* McAtee 1918) as Scott I. or Turkey I. (*cf.* U.S.G.S. topographic maps); opposite Herzog I., which is also sometimes called Turkey I. 1904.
 37. *Kenilworth*. NE D.C. 1904.
 38. *Laurel*. Prince Georges Co., Md. 1903.
 39. *Lebanon*. Name of Bartsch Estate on Pohick Bay, Potomac R. below Washington, near Lorton, Fairfax Co., Va. 1946.
 40. *Lorton*. *Cf.* no. 39. Collections from a sphagnum bog. 1917.
 41. *Military Road, Va.* Locality given as 0.5 mi. beyond Long Bridge,

which stood near present 14th St. bridges, connecting D.C. and Va. Bartsch's locality was most likely in Arlington Co., Va., because he specified "Va.," but there is presently no Military Road here. Presumably, this was not the present Military Road in NW D.C. 1917.

42. *Millers Swamp*. Locality given as 2 mi. north of Agricultural College (Maryland State Agric. College), now a part of University of Maryland, vicinity of College Park, Prince Georges Co., Md.; swamp is now extinct. 1903.
43. *Mount Vernon*. Along Potomac R. below Washington, Fairfax Co., Va. 1897.
44. *Occoquan*. Near Potomac R. below Washington, Prince William Co., Va. 1914, 1917.
45. *Old Naval Observatory*. Apparently the former National or Steele Observatory on the Mall near the Washington Monument, NW D.C. 1896.
46. *Patuxent River*. Forms boundary between Prince Georges and Anne Arundel Cos., Md., emptying into Chesapeake Bay about 55 mi. southeast of Washington. Collections came from Hills Bridge, which crosses river just east of Upper Marlboro, and from "pine woods on north bank," presumably near Hills Bridge because collections were made here on same day. 1917.
47. *Plummers Island*. Variously spelled Plummer, Plummer's, and Plummers I. Island in Potomac R. above Washington. Collections from "opposite" Plummers I., which undoubtedly meant Virginia shore of Potomac R., Fairfax Co., Va., because some collections actually were specified as from the Virginia shore "opposite" Plummers I. 1904, 1913, 1917.
48. *Potomac Bluffs, Va.* Bluffs between Stubblefield Falls and Scott(s) Run, which enters Potomac R. above Stubblefield Falls and not far above Plummers I., Fairfax Co., Va. 1904.
49. *Potomac Flats*. Low marshy and sandy flats in general region of Hains Point, SW D.C.; east shore of Anacostia R. near mouth, SW D.C.; and Alexander I., Va., near 14th St. bridges. Bartsch collections apparently came only from SW D.C. 1896.
50. *Receiving Reservoir, D.C.* Now called Dalecarlia Reservoir, lying partly in NW D.C. and partly in Montgomery Co., Md., near Potomac R. 1896.
51. *Reform School*. Cf. no. 27.
52. *Riverdale*. Prince Georges Co., Md. Collections from Cross Roads, presumably an old highway junction. 1905.
53. *Roaches Run*. Inlet of Potomac R. on Virginia shore just opposite mouth of Anacostia R., north edge of present Washington National Airport, Arlington Co., Va. 1896.
54. *Rock Creek*. Tributary of Potomac R. arising just east of Rockville, Montgomery Co., Md., flowing southward through NW D.C., and

- emptying below Georgetown. Collections from D.C. and Md. 1896, 1899.
55. *Soapstone Creek, Va.* Locality probably not in Virginia as given on labels, but in NW D.C.: Small tributary of the Broad Branch of Rock Creek (*cf.* no. 54); enters Broad Br. near the latter's mouth just north of National Zoological Park. 1904, 1905.
56. *Soldiers Home.* U. S. Soldiers Home. Large park-like grounds lie partly in NE, partly in NW D.C. 1897.
57. *Soldiers Home Reservoir.* Now called McMillan Park Reservoir or New Reservoir; within grounds of Soldiers Home (*cf.* no. 56). NW D.C. 1898.
58. *South East Corner, D.C.* Presumably southeasternmost part of Washington, SE D.C. 1917.
59. **South River.* Large inlet of Chesapeake Bay south of Annapolis, Anne Arundel Co., Md. 1917.
60. *Springvale.* Small village in northwest Fairfax Co., Va., west of Great Falls. Collections from "O'Connor's Farm." 1904, 1914.
61. **Sugar Loaf Mountain.* South of Frederick, Frederick Co., Md. 1897.
62. *Suitland Bog.* Just north of Suitland Parkway near Morningside, Prince Georges Co., Md. 1917.
63. *Terra Cotta.* South Dakota Ave. near intersection with Missouri Ave. and Riggs Road, NE D.C. 1905.
64. *Vanderwerken Station.* Old station along former Washington and Old Dominion R.R., Great Falls Branch, at present-day intersection of Old Dominion Drive and Little Falls Road, Arlington Co., Va. Collections from "Dittmars Farm." 1914.
65. *Wiehle.* Station on former Washington and Old Dominion R.R., known as Washington and Ohio Railroad before turn of century (*cf.* Ward's map, 1881), at place now called Sunset Hills, just east of Herndon, northwest Fairfax Co., Va.; (*cf.* also nos. 24, 25). 1905.
66. *Woodley Park.* Along Connecticut Ave. just west of National Zoological Park, NW D.C. 1904.

Allegheny Mountains

Bartsch's collections from western Augusta County, Virginia, were made in the southern section of the Shenandoah Mountains, which form a part of the main Allegheny Range along the Virginia-West Virginia border. The localities and years of collection are as follows: Buck Hill, 1906; Calfpasture R. near West Augusta, 1906; Jennings Branch, 1906; Jennings Gap, 1906; Little North Mountain, 1906; Mt. Solon, 1906; Stokesville, 1898, 1906; and Stribling Springs, 1898, 1906.

Blue Ridge

The Blue Ridge collections were made on the mountains and in the foothills at the following localities, listed by county, in northwestern

Virginia: *Clarke Co.*: Blue Ball Mountain, 1913; Hanging Rock, 1911, 1913; Lovers' Leap, 1911; Tilthammer Mill, 1913; Wild Cat Den, 1911, 1913. *Fauquier Co.*: Delaplane to Paris, 1913; Marshall, 1913; Paris, 1911, 1912, 1913. *Loudon Co.*: Airmont near Round Hill, 1905. *Page Co.*: Stony Man Mountain, 1913.

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BIOLOGICAL SOCIETY OF WASHINGTON

PROCEEDINGS

1038th Meeting—20 May 1966

EIGHTY-SEVENTH ANNUAL MEETING

President Charles O. Handley, Jr., called the meeting to order at 3 p.m. with about 35 members present. In the absence of the recording secretary the president read the minutes of the last annual meeting. Reports were received from the editor, the auditor, the treasurer, and the chairman of the nominating committee. The latter announced that the officers and council members listed on page *iii* were elected by a unanimous mail ballot. The president read the names of 20 new members who had been elected during the year by the council. No formal communications were scheduled.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

GEOGRAPHIC VARIATION IN AZARA'S MARSH
BLACKBIRD, *AGELAIUS CYANOPUS*

BY KENNETH C. PARKES

Carnegie Museum, Pittsburgh, Pennsylvania

Of the well-known and widely distributed icterid genus *Agelaius*, perhaps the least studied species has been Azara's Marsh Blackbird, *A. cyanopus* Vieillot, of Argentina, Paraguay, Bolivia and Brazil. It has been universally treated as a monotypic species. This is understandable in view of its general rarity in collections; those few institutions fortunate enough to possess specimens of *Agelaius cyanopus* from more than one population seldom, if ever, have series comparable as to age and sex. To complicate matters further, there is no detectable geographic variation in definitively plumaged males other than in size; all are simply black. The realization that three specimens in Carnegie Museum, long generically misidentified, actually represented an isolated and strikingly different population of *Agelaius cyanopus* led to a study of this species based on material assembled from several museums. It quickly became apparent that *A. cyanopus*, like most of its congeners, is most emphatically a polytypic species, with no less than four morphologically distinct and geographically isolated populations. Of the three outlying populations, a total of only 22 specimens could be assembled; over twice this number of the nominate race were examined.

All measurements in this paper are in mm. The wing was measured flattened against the ruler. The tail measurement is the standard one for birds, and the bill measurement is that of the total length of the culmen from the base.

Acknowledgments: In addition to specimens in the Carnegie Museum, material from the following museums was examined (abbreviations used later in the paper are noted): Academy of Natural Sciences of Philadelphia (ANSP), American Mu-

seum of Natural History (AMNH), Museu Goeldi, Belém, Brazil (MG), Museu Nacional, Rio de Janeiro, Brazil, and Peabody Museum of Natural History, Yale University. I am indebted to the authorities of these institutions for permission to borrow their specimens. In addition, valuable information was contributed toward this study by Mr. Hugh Cott of Cambridge University, Mr. Derek Goodwin of the British Museum (Natural History) (BM), Dr. F. C. Novaes of the Museu Goeldi, and Dr. Helmut Sick of the Museu Nacional.

PLUMAGE SEQUENCE

Definitively plumaged males of *Agelaius cyanopus* differ from all other members of the genus in being wholly black (slightly glossed with blue), with no red, brown or yellow on the head, wing, or elsewhere. In color they thus resemble females of the distinctive races of the Red-winged Blackbird, *A. phoeniceus* (Linnaeus), inhabiting Cuba (*assimilis*) and the Isle of Pines (*subniger*). The Jamaican *Nesopsar nigerrimus* (Osburn), which is essentially a short-legged, short-tailed arboreal *Agelaius*, is also entirely black, but is more iridescent than is *A. cyanopus*, and lacks the distinct sexual dimorphism of the latter species. I have seen no specimens which would indicate that adult males of *A. cyanopus* in freshly molted plumage have the brown feather-edgings characteristic of several of the species of *Agelaius* at this stage.

Definitively plumaged females, as well as both sexes in juvenal and first basic plumages, are completely unlike the adult males. Birds in these plumages (with the exception of one population, to be discussed beyond) are more or less heavily streaked with black and some shade of brown dorsally, have rufous or brown edgings on remiges and wing coverts, and are yellowish or greenish ventrally, the exact color varying with sex, age, and population. The underparts may also be more or less streaked with blackish.

The following descriptions of plumage sequence are based primarily on specimens of the nominate race, of which the largest series was available. In both sexes, the juvenal plumage is dull buffy yellow below, finely streaked with black on breast, upper abdomen and flanks, sometimes on throat and lower abdomen also. The number of specimens available is insufficient to be certain as to whether there is sexual dimorphism in the juvenal plumage; it is possible that males may be somewhat darker on the crown, and have the ventral streaking extending farther caudad.

Two specimens (AMNH 32835 and 149815) are believed to represent, respectively, the fresh and worn first basic plumage of the female. This, as would be expected, differs from the juvenal plumage in lacking

the rather plumulaceous or "fluffy" texture typical of juvenile passerines. In addition, the flanks are more heavily streaked than in the juvenal plumage, while the streaking of the remainder of the underparts is replaced by finer shaft-streaks which become accentuated with wear. The ground color of the underparts is more yellow, less buffy.

By the time the first basic plumage of the male (exemplified by AMNH 32836 and 521164) has been assumed, the larger size of that sex has become apparent. Young males missexed as females may be found in almost every series of this species, but may be identified by their larger size and, later, by incoming black feathers. In the first basic plumage of males, the ground color of the crown and nape is yellower, less chestnut than in females, thus contrasting more with the black central streaks. The underparts resemble those of the female, but are less streaked, sometimes virtually immaculate centrally. Few molting specimens are available, but those examined suggest that the first prebasic ("postjuvinal") molt may include both remiges and rectrices.

There is some evidence of a partial prealternate molt in young males, during which a varying number of black feathers appear on the face and throat and scattered on the underparts; these may be duller than the definitive black feathers (AMNH 128351, 521167). AMNH 32834 and 32838 are undergoing the molt into the definitive basic plumage, with certain black feathers apparently being of an older generation, *i.e.*, of the first alternate plumage. The series from any one locality is insufficient to determine the plumage cycle of adult males, but by analogy with the young and with related species, they probably have at least a limited prealternate molt.

Definitively plumaged females are less streaked below than are those in the first basic plumage, the streaking when present usually being confined to the flanks. The dorsal color is colder and less rufescent, contrasting less with the central streaks, which are broader. The material examined was inadequate to demonstrate anything more than the probability of a first (and presumably later) prealternate molt in females.

SUBSPECIES

Agelaius cyanopus cyanopus Vieillot.

Agelaius cyanopus Vieillot, Nouv. Dict. Hist. Nat., nouv. éd., 34, 1819: 552 (Paraguay, *ex* Azara).

C[assicus] T. hybridus Merrem, in Ersch and Gruber, Allg. Encycl. Wiss., 15, 1826: 279 (Paraguay, *ex* Azara).

Leistes unicolor Swainson, Anim. Menag., 1837: 304 ("Brazil"; see below).

This is the best-known subspecies, and the commonest in collections. It occupies a range far larger than that of any of the other three subspecies here recognized. The synonymy of this race calls for certain comments. Merrem's name *hybridus* is an absolute synonym of *cyanopus* Vieillot, having been based, as was the latter, on Azara's "Tordo negro



FIG. 1. Females of *Agelaius cyanopus*: left to right, *A. c. cyanopus*, Carnegie Mus. 31442, Puerto Suarez, Bolivia; *A. c. beniensis*, new subspecies, ANSP 119426, Chatarona, Bolivia; *A. c. atroolivaceus*, Mus. Nac. Rio de Janeiro 20529, Sarapuí, Brazil; *A. c. xenicus*, new subspecies (Type), Carnegie Mus. 68658, Arucauá, Brazil.

y vario." The next name listed by Hellmayr (1937: 180) in the synonymy of *cyanopus* is "(?) *Icterus atro-violaceus* Wied," 1831. This is a *lapis* on Hellmayr's part for *Icterus atro-olivaceus* (neither version, incidentally, appearing in Hellmayr's index), a name revived for another subspecies in the present paper, beyond. Then comes *Leistes unicolor* Swainson, 1837, which bears no locality other than "Brazil." Three of the four subspecies are found within the borders of Brazil, so identification of Swainson's types was imperative. The specimens are still extant, in the Cambridge University Museum of Zoology, where Mr. Hugh B. Cott was kind enough to examine them for me. His description of Swainson's

female cotype indicates that *unicolor* is a synonym of *cyanopus*, and I therefore hereby restrict the type locality of *unicolor* to the Rio Paraná, Brazil, a source of other early specimens of this species (Sclater, 1886: 345). Gyldenstolpe (1945: 265) apparently misread the footnote by Hellmayr (1937: 180, footnote 2), as he cites, in his synonymy of *Agelaius cyanopus*, "*Leistes unicolor* Swains. Anim. in Menag. p. 304, 1837 (ex D'Orbigny)—'Brazil' (errore) = E. Bolivia." The reference to d'Orbigny and the correction of the type locality to eastern Bolivia apply not to Swainson's *unicolor* but to another name, *Agelaius xanthocarpus* (not "*xanthoscarpus*" as spelled by Hellmayr, 1937: 180) Bonaparte (1850: 430), alleged to have come from "Peru," not Brazil. Gyldenstolpe's citation is clearly a *lapsus* and does not affect the restriction of the type locality of *unicolor* Swainson, above.

Hellmayr examined the cotypes in the Paris Museum of Bonaparte's *Agelaius xanthocarpus* (Hellmayr, 1937: 173; 180, footnote 2). He found them to be examples of the Chilean race of *Agelaius thilius*, whereas the description of the female was based on a d'Orbigny specimen of *A. cyanopus* from Chiquitos, eastern Bolivia. Birds from the latter area are referable to nominate *cyanopus*, so no nomenclatorial complications ensue. The name *xanthocarpus* Bonaparte clearly belongs in the synonymy of *thilius*, but in view of the composite nature of Bonaparte's original description it may well be desirable to stabilize the name *xanthocarpus* by considering as its lectotype the immature male specimen of *thilius* upon which Bonaparte (according to Hellmayr) based his description of the male.

Measurements: 13 adult males, wing 91–97 (93.7); tail 77.5–86 (82.4); culmen 23.5–25.5 (24.5). 13 adult females, wing 83–90.5 (86.0); tail 70–80.5 (75.6); culmen 21.5–23.5 (22.5).

Range: Eastern Bolivia (Dept. Santa Cruz), southern Brazil (Matto Grosso, Goiás, São Paulo, Paraná), Paraguay, and eastern Argentina from Formosa and Misiones south to Buenos Aires. In Brazil, this form does not appear to have been recorded east of the Rio Paraná except in northwesternmost São Paulo (localities given by Pinto, 1944: 576–577). Although it occurs east of the Paraná in Argentina, it has not been recorded from Uruguay (Cuervo and Gerzenstein, 1962). Hellmayr (1937: 180, footnote 3) was skeptical about the validity of a record of *Agelaius cyanopus* from Barracas al Sud, Prov. Buenos Aires, Argentina (Hartert and Venturi, 1909: 185), as he did not believe this species occurred as far south as Buenos Aires. He pointed out that the record was "based on a single young bird," originally listed as "♂ juv." I have examined this specimen, which came to the American Museum of Natural History with the Rothschild collection (now AMNH 521164). It is a perfectly typical example of *A. c. cyanopus*, a male in fresh first basic plumage. This bird might be considered a stray were it not for the fact that an additional AMNH specimen of *cyanopus* from Buenos Aires Province is an almost certainly locally-raised juvenile. It is the specimen listed by Hartert and Venturi (*loc. cit.*) as "♂ juv." of "*Agelaius thilius*

chrysocarpus" from Flores. This specimen is unequivocally *A. cyanopus* and not *A. thilius*; the two species are easily separable in juvenal plumage. Two additional specimens from Buenos Aires Province are listed by Pereyra (1938: 251), who also discusses the distribution and habits of the species in this part of Argentina.

Agelaius cyanopus atroolivaceus (Wied).

Icterus atro-olivaceus Wied, Bietr. Naturg. Bras., 3 (2), 1831: 1216 ("an der Ostküste von Brasilien, in der Gegend von *Coral de Batuba*, bei der *Lagoa Feia*, zwischen den 22sten und 23sten Grad südlicher Breite" [= Curral de Batuba, near Lagôa Feia, Est. Rio de Janeiro, Brazil; see Pinto, 1944: 576, footnote]).

The International Code of Zoological Nomenclature, articles 27 and 32c (i), requires the deletion of the hyphen in Wied's original spelling "*atro-olivaceus*." As noted above, Hellmayr (1937: 180) inadvertently listed this name as "*atro-violaceus*"; this misspelling was repeated by Pinto (1944: 576, footnote) and by Schneider and Sick (1962: 12).

Hellmayr did not examine Wied's type, but commented (1937: 180, footnote 1) that the description "agrees none too well with the characters of the present species [*cyanopus*]," and that "the locality, coast of Rio de Janeiro, furthermore, is far away from its established range." He suggested (p. 181, footnote) that there might be some relation between *atroolivaceus* and the mysterious *Agelaius forbesi* Sclater, known from a single specimen from Pernambuco.

The Wied type, an adult female, is now no. 4731 in the AMNH collection, where I have examined it. My first impression was that this specimen, in remarkably good condition despite its age of over 130 years, was a discolored specimen of nominate *cyanopus*, perhaps a vagrant to Rio de Janeiro. Helmut Sick, however, called my attention in correspondence to the paper by Schneider and Sick (1962), listing additional specimens of this species from the state of Rio de Janeiro, and was kind enough to send me these specimens. Comparison of this series with Wied's type makes it clear that all of these birds belong to an isolated population of *Agelaius cyanopus*, whose distinctive characters account for the discrepancies noted by Hellmayr.

Black-plumaged males of *atroolivaceus* differ from those of nominate *cyanopus* only by having a somewhat greater average culmen length (see measurements). Females and young males differ, plumage for plumage, from *cyanopus* in being very much darker both above and below. The underparts of adult females are deep olive green instead of the rather bright greenish yellow of *cyanopus*, and there is more difference between the underparts color of adult females and both males and females in first basic plumage than is true of *cyanopus*. Dorsally *atroolivaceus* is much more heavily pigmented, with greatly reduced contrast between edgings and centers of feathers of the crown, nape, mantle, wing coverts and remiges. The brightest specimen of *atroolivaceus* is the one from

Petrópolis listed as a female by Schneider and Sick. It was sexed on the label as a male by the collector, J. Hidasi, and its measurements (wing 92, tail 81+ [worn], culmen 25) as well as a few black feathers on the throat indicate that the collector's sexing was accurate. This specimen, of all of the *atroolivaceus* seen, most nearly approaches *cyanopus* in color, but has darker, duller and narrower edgings on the feathers of the upperparts and wings.

Measurements: males, wing 92, 94.5, 95, 95; tail 81, 83, 84, 86; culmen 25, 25.5, 26. Females, wing 84.5, 85, 87.5, 88; tail 74, 75.5, 79, 80; culmen 22, 23, 23.5, 24.

Range: Known only from the state of Rio de Janeiro, Brazil, from the following localities: Lagôa Feia (Curral de Batuba and Ponta Grossa; see Pinto, 1944: 576), Petrópolis, Sarapuí, and a sight record from Lagôa Jacarepaguá, the latter within the limits of the city of Rio de Janeiro (Schneider and Sick, 1962: 12).

***Agelaius cyanopus beniensis*, new subspecies**

Holotype: Acad. Nat. Sci. Philadelphia no. 119424, adult female, Chatarona (600 feet), Dept. El Beni, Bolivia, collected 20 September 1934 by M. A. Carriker, Jr. (original no. 10110).

Characters: Wing and tail decidedly and culmen slightly longer than those of any other population, with size difference best expressed in males. Females, plumage for plumage, are slightly deeper and less yellowish in color on the underparts than *cyanopus* (although not as dark as *atroolivaceus*), with flanks and under tail coverts duskier. Definitely plumaged females are blackish above, equalling or exceeding *atroolivaceus* in saturation, but females in first basic plumage are not much darker dorsally than *cyanopus*. Females of both age classes of *beniensis* have blackish or dark olive under wing coverts, as do females and young males of *atroolivaceus*, whereas in *cyanopus* these feathers are yellow. No young males of *beniensis* have been seen, but they presumably match females in dark coloration.

Measurements: males, wing 98, 101, 102; tail 86.5, 88, 93.5; culmen 24, 24, 26. Females, wing 88.5, 90.5, 92, 92, 93; tail 77, 78, 82, 83.5, 85; culmen 22, 23, 23, 24, 25. For additional measurements, see *Remarks*, below.

Range: Known only from a small area of the western portion of Dept. El Beni, Bolivia, near the Río Beni (Chatarona, Reyes, El Consuelo). For a description of the type locality, see Bond and de Schauensee, 1942: 311.

Remarks: I have not examined the series from El Consuelo reported by Gyldenstolpe (1945: 265), but the wing measurements given are clearly those of *beniensis*. Gyldenstolpe did not state the number of specimens actually measured, but his total series consisted of 9 adult ♂ ♂, 4 "juv." ♂ ♂, and 8 ♀ ♀ (age not specified). His measurements are as follows: males, wing 100–104; tail, 82–88. Females, wing 86–93; tail

70-78. Gyldenstolpe's tail measurements seem small; perhaps some of these birds were molting. His bill measurements are not given here, as he measured "exposed" rather than total culmen, so our figures are not comparable.

In addition to the series reported respectively by Gyldenstolpe and by Bond and de Schauensee, there is a hitherto unpublished record of *Agelaius cyanopus* from this portion of Bolivia. An adult female of *beniensis* was collected by Luis E. Peña at Reyes on 9 December 1956; the specimen is now no. 38861 in the collection of the Peabody Museum of Natural History, Yale University.

The range of this subspecies may well be larger than here described, as much of northern Bolivia has been inadequately explored ornithologically. The Río Beni is a tributary of the Amazon, whereas the area occupied by nominate *cyanopus* lies wholly (or almost wholly) within the drainage of the Río Paraná. If the range of *beniensis* is, as postulated above, larger than now known, the two forms may possibly meet somewhere in the vicinity of the drainage divide in northeastern Bolivia.

***Agelaius cyanopus xenicus*, new subspecies**

Holotype: Carnegie Museum no. 68568, adult female, Arucaú, Terr. Amapá, Pará, Brazil, collected 12 June 1918 by S. M. Klages (original no. 16919).

Characters: Definitively plumaged males wholly black, as in other races, but females and male in first basic plumage completely unlike any other population of *Agelaius cyanopus*, as follows: entire head, mantle and breast black, the mantle feathers narrowly edged with dark olive-brown (females) or very dark chestnut (young male); rump and upper tail coverts black washed with dark olive; inner secondaries, tertials and greater coverts narrowly edged with dark brown (disappearing with wear); flanks and under tail coverts blackish olive; abdomen dark olive, somewhat yellower posteriorly (especially in first basic plumage), and mixed anteriorly with traces of chestnut (more conspicuous on the young male); dark olive feathers of anterior portion of abdomen with somewhat lighter centers, giving the effect of vague streaking.

In addition to the type, there is a second female specimen in the Carnegie Museum collection, taken at the same locality a week later. I would judge this to be a year-old bird, just prior to the commencement of its second prebasic molt (it, like the type, is quite worn). There is no way of knowing whether it had undergone a prealternate molt. The base of its lower mandible is brown, not black, ordinarily a character of young individuals of this species. It differs from the type as follows: olive-brown edgings of mantle paler, more distinct (and probably broader when unworn); rump not as dark olive; posterior abdomen brighter, more yellowish olive; black feathers of lower breast as well as adjacent olive feathers of upper abdomen with narrow pale central streaks.

The small series available suggests that *xenicus* may average somewhat

longer-winged than either *cyanopus* or *atroolivaceus*; the bills of this subspecies, while averaging only slightly shorter than those of other races, are noticeably stockier and less attenuated in profile.

Measurements: males, wing 94.5+ (worn), 96+, 99; tail 80.5+, 82+, 85+; culmen 23, 23.5, 23.5. Females, wing 87+, 89+; tail 74.5+, 77+; culmen 22, 23.

Range: Known from three rather widely separated localities in north-eastern Brazil: the type locality, in the drainage of the Rio Oyapock (Oiapoque) near the French Guiana border; Arumanduba, on the north bank of the lower Amazon in Pará; and São Bento, on the small Rio Aurá west of the Baía de São Marcos in northwestern Maranhão. The species has not been authentically reported from French Guiana; a "Cayenne" specimen in the Rivoli collection, now ANSP no. 3607, is an adult male which appears to be too slender-billed for *xenicus*; its wing measurement is slightly shorter (94 mm, unworn) and its culmen slightly longer (24 mm) than those of any of the three male *xenicus* measured. The type locality of *xenicus* is so close to the border of French Guiana, however, that *Agelaius cyanopus* may be expected to occur in the latter country.

Remarks: The type locality was written "Rocaua, Uassá Swamp, N. Pará" on the labels of the collector, S. M. Klages. This was a phonetic rendition, the current spellings being "Arucaúá" and "Uaçá," respectively. Todd (1942: 369) has already explained that he had misread Klages' handwriting and given this locality as "Rocana" in earlier papers based on this collection. According to Klages' field notes, the Rio Arucaúá runs through the center of what is, in the rainy season (December to July), a vast swamp formed by the flooding of virtually the entire Uaçá basin, forming what Klages called "the Great Uassá Swamp." Several igneous outcroppings form islands during this wet period. Klages' camp, from which collecting excursions were made into the swamp by canoe, was on a small unnamed island close to the locality marked as "Arucaúá" (which at the time of Klages' visit was apparently an Indian village of a few huts) on sheet N.A. 22 of the "Millionth Map" (Brazilian Provisional Edition of 1922 examined).

The only collector other than Klages known to have obtained specimens from this outlying northeastern population of *Agelaius cyanopus* was Emilia Snethlage. She listed one adult male, four young males and one female from Arumanduba (Snethlage, 1914: 421). I have been able to locate only two of these specimens. One was loaned to me through the kindness of Dr. F. C. Novaes, Curator of Birds at the Museu Goeldi, Belém (formerly Pará), Brazil. Dr. Novaes informs me that this specimen is the only one of the original six still in the Museu Goeldi, and it is in very poor condition. It appears to have been both water-soaked and badly attacked by insects at some time in the past, and it is possible that some of the other specimens in this series were completely destroyed at that time. The specimen examined is MG no. 10378 (original Snethlage no. 255), collected at Arumanduba 30 December 1912. It is sexed "♂" and appears to have been in juvenal plumage. Feathers are completely

absent from the entire throat, breast and abdomen, being present on the underparts only on the flanks and under tail coverts. The upperparts are badly chewed, as are the wings and tail, but are obviously much darker than the equivalent plumage of *A. c. cyanopus*. The greater wing coverts and tertials are edged with chestnut, again very much darker than in *cyanopus*. The head and back appear to have been black, washed slightly with greenish at the sides of the neck; a vague, dull yellowish moustachial streak remains on one side. The flank feathers are paler than those of a male in first basic plumage (to be mentioned below), but darker than those of juvenile *cyanopus*. This specimen suggests that the juvenal plumage of *A. c. xenicus* may resemble in pattern those of the other races rather than having the entire head, neck and breast black as in later plumages. Snethlage's description of the female of "*Agelaius [sic] cyanopus*," "*parte inferior amarella olivacea indistinctamente raiada de enegrocido*," suggests that her single female from Arumanduba was a juvenile.

The second Arumanduba specimen known to be extant is that upon which the description of the first basic plumage of the male, above, is based. It was exchanged to the American Museum of Natural History (where it is now AMNH 128981) at some time prior to the disaster which befell the juvenile male, and is happily in excellent condition. It is upon this specimen that the identification of the Arumanduba population with *xenicus* rests, and it clearly belongs to the same subspecies as the two females from the type locality.

The third locality in northern Brazil from which *Agelaius cyanopus* has been recorded is São Bento, Maranhão (Snethlage, 1926: 61). Only one specimen was collected. It is now no. 15792 in the collection of the Museu Nacional in Rio de Janeiro, and was loaned to me through the courtesy of Dr. Helmut Sick. Unfortunately, it is an adult male and thus useless for color comparisons, but its long wing (99 mm) and its stubby, non-attenuated bill indicate that it belongs with *xenicus* as would be expected on geographic grounds.

Sclater (1886: 345) listed a specimen in the British Museum as an adult female from "Para (?)." Mr. Derek Goodwin was kind enough to send me a description of this specimen (BM no. 1845.8.25), which is clearly *not* an adult female of *xenicus*. Mr. Goodwin states that there is no indication of sex on the label, and that he suspects "it is a male juvenile as another one rather like it but not quite so dark (BM no. 1885.11.2.291, no locality) is moulting into black plumage." Mr. Goodwin's description of the upper parts as "very dark reddish brown with prominent dark striations" is not compatible with the one apparently juvenile male of *xenicus* known, the damaged specimen from Arumanduba. In all, the description suggests that the specimen from "Para (?)" may be an example of *atro-olivaceus*, but in any case the locality can safely be said to be erroneous, justifying the original query.

The name chosen for this subspecies, from the Greek *xenikos*, strange or foreign, is intended to reflect both the decidedly different appearance

and the remoteness of the range in relation to the other populations of *Agelaius cyanopus*.

SUMMARY

Azara's Marsh Blackbird, *Agelaius cyanopus*, is not a monotypic species as previously considered. There are four subspecies, one of wide distribution, the other three isolated and local. These are, respectively, nominate *cyanopus* from the Río Paraná drainage in eastern Bolivia, Paraguay, southern Brazil, and northeastern Argentina; *atroolivaceus*, a dark, slightly longer-billed race from the coast of Rio de Janeiro, Brazil; *beniensis*, new subspecies, a large dark race from the vicinity of the Río Beni, northern Bolivia; and *xenicus*, new subspecies, a melanic, stout-billed race from northeasternmost Brazil. The plumage sequence is outlined as well as can be determined from limited material. Geographic variation in color is confined to young of both sexes and adult females, as all adult males are wholly black.

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PROCEEDINGS
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TWO NEW SOUTH AMERICAN MITES
(ACARI : ORIBATEI)

BY HAROLD G. HIGGINS
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In a collection of mites taken from vegetation in British Guiana by Donald De Leon of Erwin, Tennessee, are several species of oribatid mites new to science. Among these are specimens of the genera *Chaunoproctus* Pearse and *Calobates* Balogh which according to Balogh (1961) have previously been reported only from Java, Africa and Africa respectively. Descriptions of these new species are as follows. All types are deposited in the University of Utah collections.

***Chaunoproctus deleoni*, new species**

(Figs. 1-3)

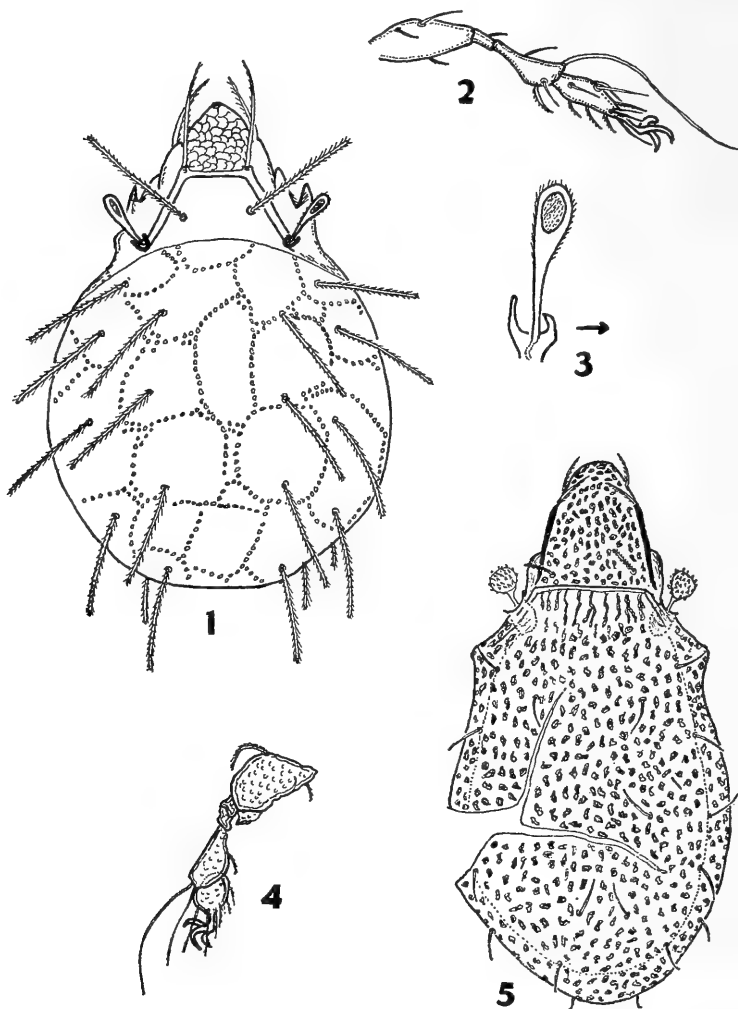
Description: Propodosoma broadly triangular, nearly one-fourth the total length; lamellar and interlamellar bristles of nearly equal length and about the length of propodosoma; lamellae narrower anteriorly and connected with a distinct but reduced anterior translamellae; pseudostigmata cup-like, the straight posterior margin higher than the posteriorly curved, anterior margin (Fig. 3); pseudostigmatic organ with narrow pedicle and an expanded, flattened, rounded, setose head; dorsosejugal suture curved and reduced.

Hysterosoma circular with ten pairs of heavy, long, blunt, setose bristles as shown in Fig. 1; dorsal setae of nearly equal length and equal in length to the interlamellar bristles; pits on dorsum forming an irregular, polygonal design.

Size: $315\ \mu \times 225\ \mu$.

Locality: Holotype from Nature Reserve, 1 mile from the 24-mile post, Bartica-Potaro Road, British Guiana, 28 October 1963, by Donald De Leon on *Simaba multiflora*; one paratype with same data as holotype, but collected on *Licania laxiflora*.

Discussion: This species is named in honor of the collector, Donald De Leon. It resembles somewhat the African species *Chaunoproctus vargai* (Balogh), but differs in the length of bristle *ta*, pseudostigmata and pseudostigmatic organs, and the presence of the irregular, polygonal design on the dorsum of the hysterosoma.



FIGS. 1-5. *Chaunoproctus deleoni*, n. sp. —1, dorsal view; —2, leg I; —3, pseudostigmata with pseudostigmatic organ. *Calobates antichthon*, n. sp. —4, leg II; —5, dorsal view.

***Calobates antichthon*, new species**
(Figs. 4-5)

Description: Propodosoma with nearly parallel sides, about one-fourth the total length; lamellar and interlamellar bristles setose, of nearly

equal length, with the interlamellar bristles more robust; lamellae narrow straps along margins of propodosoma; pseudostigmata cup-like and nearly completely covered by dorsal body wall; pseudostigmatic organs with expanded, round, setose heads on a narrow pedicle; dorso-sejugal suture nearly straight.

Hysterosoma broadly oval with ten pairs of fine, smooth bristles as shown in Fig. 5; body covered with irregular, darkened tubercles.

Size: $430\ \mu \times 225\ \mu$.

Locality: Holotype from near 24-mile post, Bartica-Potaro Road, British Guiana, 2 November 1963, by Donald De Leon on *Anaxagora neglecta*.

Discussion: A single, broken specimen of this new species is all that is available for study. *Calobates antichthon* is similar to *Calobates ornatis-sum* (Balogh) but differs in the rounder, larger pseudostigmatic organs, a much straighter dorsosejugal suture, and the dorsal surface is covered with an irregular pattern of tubercles rather than having them arranged in a polygonal network.

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PROCEEDINGS
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A NEW SPIDER HUNTING WASP OF THE SUBGENUS
DIPOGON FROM WESTERN NEVADA
(HYMENOPTERA: POMPILIDAE)

BY MARIUS S. WASBAUER

California Department of Agriculture, Sacramento

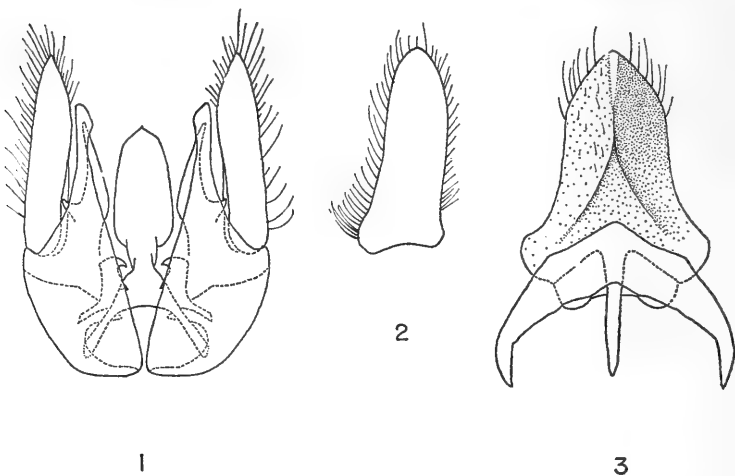
The pepsine subgenus *Dipogon* is a small and homogeneous assemblage, the members of which apparently utilize pre-existing holes in wood or hollow twigs for their nesting activities. The individuals are small, averaging about 5 mm in length, are rarely encountered in the normal course of general collecting and, hence, are uncommon in collections.

Townes (1957: 131) reviewed the group and recognized five species. Since then, two additional species have been described from California (Wasbauer, 1960: 171). The following new species brings to eight the total currently recognized for the Nearctic fauna. The species is described at this time to make the name available for biological studies now underway.

In the following description, terms relating to the measurements of the head are those used by Evans (1950: 137-138) in his revision of the pompilinae wasps.

Dipogon (Dipogon) parkeri Wasbauer, new species

Female: Length 5.1 mm. Forewing 4.3 mm. Head, thoracic dorsum and abdomen dull, minutely puncto-reticulate, sides of thorax subshining. Pubescence relatively abundant over most of body, consisting of rather long, appressed, silvery hairs, shortest on head and pronotum, longest and most dense on abdominal terga, investing abdomen with a faintly silvery sheen. Integumental color orange-brown, the following areas blackish: head above antennae, between antennal sockets, fronto-clypeal suture, first three antennal segments (lightly suffused), pronotum dorsally, mesonotum, scutellum, postscutellum, metanotum, propodeum dorsally, mesepisternum ventrally, mid coxae dorsally, outer surfaces of fore femora, mid and hind femora and tibiae, basal half of hind basitarsus and abdomen except for a narrow pale area laterally on first and cocoon and microvial containing genital structures in glycerine; aedeagus



FIGS. 1-3, male genital structures of *Dipogon parkeri*. Fig. 1, male genitalia, dorsal view. Fig. 2, right paramere, external view. Fig. 3, subgenital plate, ventral view.

second terga. Head: considerably broader than long, facial distance .85 the transfacial; compound eyes slightly convergent above, upper interocular distance .89 lower interocular distance; ocellar triangle with the front angle a right angle; posterior ocelli equidistant from each other and inner margins of compound eyes; clypeus slightly convex, subtruncate apically, with a row of ill-defined, large punctures before the apex and a number of long, apically directed hairs, apical margin minutely reticulate, without appressed hairs. Thorax: posterior margin of pronotum arcuate; propodeum without a median longitudinal sulcus, nearly evenly convex, posterior slope with a slightly flattened area; forewing with narrow, light infuscation over basal vein, larger diffuse infusate area over apex of first submarginal and first discoidal cells, marginal cell except apically, first submarginal second submarginal and third discoidal cells; microtrichiae slightly stronger in infusate areas than between and basad of them; nervulus beyond basal vein by .44 its length; first recurrent vein meeting second submarginal cell beyond its basal third, cubital and subdiscoidal veins reaching wing margin; second submarginal cell 1.5 length of third. Abdomen: first tergum with a number of silvery-white, erect hairs anteriorly in addition to the appressed pubescence.

Male: Length 3.5 mm. Forewing 3.4 mm. Head and thoracic dorsum dull, sides of thorax and abdomen subshining; head minute, granulo-reticulate without noticeable punctures except on vertex between lateral ocelli and occiput, punctures very small, shallow on pronotum dorsally,

somewhat deeper on mesonotum, scutellum and postscutellum, shallow, scattered on propodeum and abdomen. Integumental color black, the following areas orange-colored: clypeus medially, antennae basolaterally, mandibles apically, posterior margin and sides of pronotum, fore femora apically, fore tibiae and tarsi. Head: sparsely clothed with rather short, decumbent, whitish hairs, somewhat longer on lower face and clypeus; about 15 longer, erect, straw-colored hairs on vertex; front angle of ocellar triangle a right angle; lateral ocelli nearer to compound eyes than to each other, postocellar distance 1.3 ocellocular distance; front rather broad, middle interocular distance .64 transfacial distance; disk of clypeus evenly convex, apex simple, subtruncate. Thorax: posterior margin of pronotum arcuate; scutellum convex, somewhat raised above level of posterior portion of mesonotum; propodem descending to apex in a nearly even curve, basolateral portions shining, impunctate, posterior surface with large, shallow, irregular punctures; forewing very faintly infusate over basal vein, a large faint infusate area over proximal third of first submarginal cell, basal half of marginal cell, second and third submarginal cells and apical portion of second discoidal cell; nervulus beyond basal vein by 0.5 its length; hindwing with segment of mediella between submediella and cubitella .88 the length of intercubitella. Abdomen: genitalia and subgenital plate as in Figs. 1, 2, and 3.

Holotype female and allotype male, Mustang, Washoe County, Nevada (F. D. Parker, collector). Holotype pinned with cocoon; allotype with separate from genital capsule. The holotype and allotype have been deposited in the collection of the University of California at Davis.

This species is most closely related to members of the *brevis* group of Townes (*op. cit.*) other than *D. brevis*, sensu lato. The sculpturing of the integument is similar to *D. diablo* Wasbauer although it differs in integumental color and configuration of the genitalia and subgenital plate.

Mr. Parker states, in personal communication, that this species was taken during the summer of 1963 nesting in the stems of *Sambucus*. The stems were cut and placed in various localities to gain information on the biology of twig-nesting solitary bees and wasps.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF MALLOPHAGA
(ISCHNOCERA: *DEGEERIELLA*)
FROM THE CARACARA

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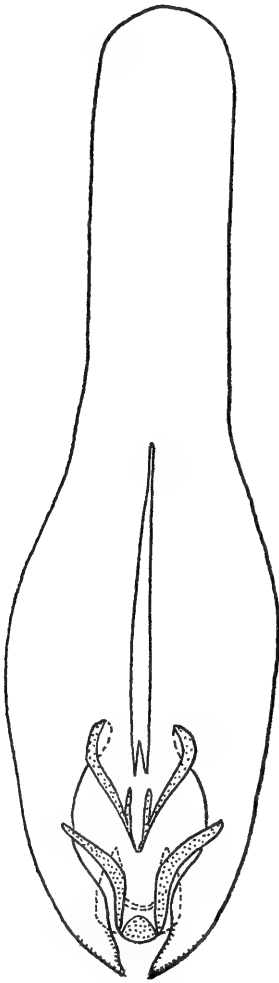
Through the courtesy of Dr. Donald Tuff, I recently received a small series of *Degeeriella* collected off the Caracara, which represent an interesting new species. That species is here-with described, and the male genitalia, which is unique, is illustrated.

***Degeeriella pricei*, new species**

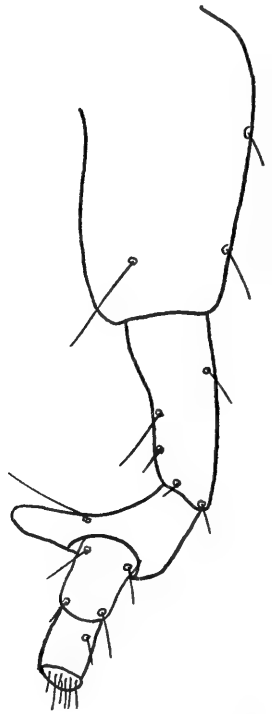
Holotype male: Head similar to *D. mookerjeei* Clay, 1957 except that the anterior margin of the head is straight, and the ocular setae are as long as those of the temporal margins. Antennae as illustrated in figure 2. Chaetotaxy of the posterior margin of the pterothorax as in *D. rufa* (Burmeister, 1838). Shape and chaetotaxy of the thoracic sternal plate as in *D. mookerjeei*, with a normal variation between individual specimens. Pleural thickening of abdominal segments, narrow as in *D. guimaraesi* Clay, 1958. Abdominal tergites entire, but II with a central concave area. Abdominal tergite II with four long setae on the posterior margin and four long setae around the concave area. Chaetotaxy of abdominal tergites III-IX, each with eight long setae on the posterior margins. Abdominal sternite II with four centrally located long setae. Abdominal sternites III-VI, each six long setae on the posterior margins. Terminal abdominal segment with 24 long marginal setae. Genitalia as illustrated in Fig. 1. Total length, 2.41 mm.

Allotype female: Except for the antennae, similar to the male in form and chaetotaxy of head and thorax. Except for terminal segments, abdomen similar to that of the male in form and chaetotaxy. Posterior margin of vulva indented centrally, with twenty medium-length setae; and with eight small setae located centrally anterior to the posterior margin. Total length 2.68 mm.

Discussion: This species is apparently closest to *D. mookerjeei*, found on *Pernis ptilorhynchus gurneyi* Stresemann, a bird of Southeast Asia. These two species are the only known species of *Degeeriella* in which the males have enlarged antennae. The male genitalia of the two species



1



2

Degeeriella pricei, holotype. FIG. 1. Male genitalia. FIG. 2. Male antenna.

are quite different. Clay has provided an excellent illustration of the male genitalia of *D. mookerjeei*. The greatest differences are in the shape of the endomeral plate and the mesome. The lateral extensions of the endomeral plate are curved outward in *D. pricei* and not in *D. mookerjeei*. The mesome of *D. pricei*, as may be seen in the illustration, is unique.

Type material: Holotype male, allotype female and paratypes were collected off *Caracara cheriway* (Jacquin), at Ciudad Victoria, Mexico, on 8 July 1962 by M. A. Price. The holotype and allotype will be deposited in the collection of the U.S. National Museum.

LITERATURE CITED

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- . 1958. Revisions of Mallophaga Genera. *Degeeriella* from the Falconiformes. Bull. Brit. Mus. (N. H.), Entomol. 7 (4): 123-207.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NEW SPECIES OF NORTH AMERICAN *AMMOPHILA*,
PART II¹ (HYMENOPTERA, SPHECIDAE)

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Several workers conducting biological studies on *Ammophila* in North America have sent material to me for identification. In some cases undescribed species are involved. It is desirable therefore, to establish these names now so that they will be available to biologists. Because descriptive terminology will be dealt with in my revision of the genus (now in progress), no explanation of terms is given here. Likewise, discussion of species variation, relationships and distribution are minimal in this paper. The following abbreviations have been used to indicate deposition of type material:

AMNH—American Museum of Natural History, New York; ASU—Arizona State University, Tempe; CAS—California Academy of Sciences, San Francisco; CIS—California Insect Survey, Berkeley; CMP—Carnegie Museum, Pittsburgh; CNC—Canadian National Collection, Ottawa; CNHM—Chicago Natural History Museum, Chicago; CSDA—California State Department of Agriculture, Sacramento; CUI—Cornell University, Ithaca; LACM—Los Angeles County Museum, Los Angeles; NSDA—Nevada State Department of Agriculture, Reno; OSU—Oregon State University, Corvallis; PARIS—Museum d'Histoire Naturelle, Paris, France; SDM—San Diego Natural History Museum, San Diego; UCB—University of Colorado, Boulder; UCD—University of California, Davis; UCR—University of California, Riverside; UKL—University of Kansas, Lawrence; UMSP—University of Minnesota, St. Paul; USNM—United States National Museum, Washington, D. C.

The first six *Ammophila* described here belong to a large assemblage of species I am calling the *urnaria* group. All members have a short preëpisternal sulcus. The clypeus, frons, and pronotal lobe are covered with appressed silver hair and the erect body hair is pale. The pronotal collar and scutum are usually smooth, without transverse ridges. The metapleural flange usually is not lamellate and the male clypeus is commonly emarginate. This New World group includes the following United

¹ A byproduct of research supported by a Sigma Xi-RESA Grant-in-Aid.

States species: *aberti* Haldeman, *bellula* Menke, *cleopatra* Menke, *juncea* Cresson, *kennedyi* (Murray), *leoparda* (Fernald), *parkeri* Menke, *picipes* Cameron and *urnaria* Dahlbom. The following extralimital forms belong in the *urnaria* group: *dejecta* Cameron (Mexico), *gracilis* Lepeletier, *lampei* Strand, *rufipes* Guérin-Méneville, *arechavaletai* Brèthes, *platensis* Brèthes, and *suavis* Burmeister (all South American).

***Ammophila aellos* Menke, new species**

Holotype male: Length 18 mm.

Color: Black; tegula reddish; petiole tergite red laterally, black above; gastral segments I–II red, tergite I with a median black stripe, II broadly black posteriorly; front and middle femora apically, and tibiae red; wings clear, veins brown.

Vestiture: Appressed clypeal hair thinning anteromedially, gena along outer orbit sparsely covered with appressed silver hair; mesopleuron with band of appressed silver hair along mesopleural suture from base of mid coxa to top of hypoepimeral area; inferior metapleural area with band of appressed silver hair near base of hind coxa which crosses metapleural sulcus and extends onto propodeal side, ending anterior to propodeal spiracle, band weaker on propodeal side.

Structure: Labrum truncate; collar densely micropunctate, moderately macropunctate; scutum densely micropunctate and macropunctate; scutellum ridged and punctate; mesopleuron densely macropunctate anteriorly, moderately so posteriorly; inferior metapleural area and propodeal side densely macropunctate.

Female: Length 18 mm.

Color: As in male except tegula, petiole, and gastral segments I–III and tergite IV laterally, red, tergite III broadly black posteriorly; front and middle legs red except coxa, trochanter and base of femur; hind femoral apex and tibia red.

Vestiture: As in male except gena densely covered with appressed silver hair; pronotal collar with appressed silver hair; scutum with a posteromedian longitudinal band of appressed silver hair.

Structure: Labrum truncate but bearing a median projection; clypeal disk moderately bulging, sparsely to moderately macropunctate, median free margin projecting, teeth well formed; inner orbits moderately converging below.

Types: Holotype male: 8 mi. S Guadalajara, Jalisco, Mexico, 10 July 1963, L. Stange and F. Parker (UCD). Nine male and three female paratypes as follows: MEXICO, GUERRERO: Chilpancingo, 24 July 1961, R. and K. Dreisbach (UCD). 3 mi. N Taxco, 5500 ft, 1 June 1959, H. E. Evans (CUI). JALISCO: 8 mi. S Guadalajara, 10 July 1963, L. Stange and F. Parker (UCD). Guadalajara, no further data (UCD). MORELOS: Atlatlahucán, 24 July 1963, F. Parker and L. Stange (UCD). Xochicalco Pyramid, 16 July 1963, F. Parker and L. Stange (UCD).

Discussion: In some males the front and middle legs have only a small red spot at the femoral apex and no red on the tibiae. This species

is most similar to *mescalero* but the form of the collar is distinctive in the latter. Males of *mescalero* usually lack the black spot on gastral tergite II which is not true for *aellos*. *Ammophila aellos* is known only from Mexico.

***Ammophila aucella* Menke, new species**

Holotype male: Length 22.5 mm.

Color: Black; petiole tergite red laterally; gastral segment I red, tergite with elongate median black spot; wings clear, veins brown.

Vestiture: Mesopleuron with band of appressed silver hair along mesopleural suture from base of mid coxa to top of hypopimeral area; inferior metapleural area with band of appressed silver hair near hind coxal base which crosses metapleural sulcus and extends onto propodeal side, band ending anterior to propodeal spiracle, band weaker on propodeal side.

Structure: Labrum broadly acuminate; collar moderately macropunctate; scutum densely macropunctate; scutellum punctate, ridged; pleura and propodeal side densely macropunctate.

Female: Average length 23 mm, range: 20–23 mm.

Color: As in male except gastral segments I–II red, distal half of tergite II black, tergite V red.

Vestiture: As in male except gena sparsely covered with appressed silver hair; scutal furrows with appressed silver hair.

Structure: Labrum acuminate; clypeal disk moderately bulging, moderately macropunctate, median free margin projecting, teeth well formed; inner orbits moderately converging below; collar sparsely macropunctate.

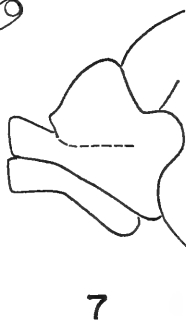
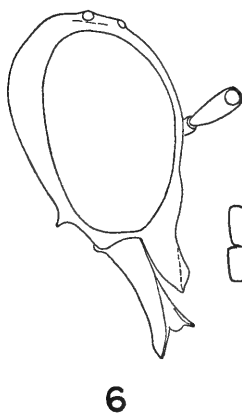
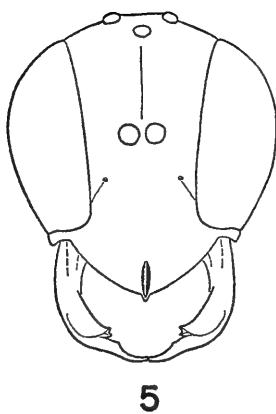
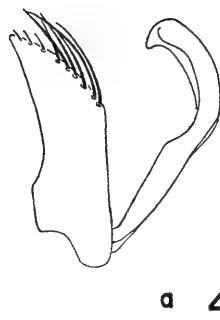
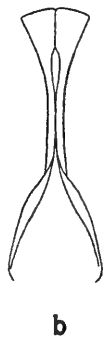
Types: Holotype male: 3 mi. SE Plan de Barrancas, Jalisco, Mexico, 8 July 1963, F. Parker and L. Stange (UCD). Six male and six female paratypes as follows: MEXICO, GUERRERO: Iguala, 30 June 1935, A. Pritchard (UMSP). JALISCO: 3 mi. SE Plan de Barrancas, 8 July 1963, F. Parker and L. Stange (UCD). GUADALAJARA, no further data (UCD). MICHOACAN: Apatzingán, 1200 ft, 18 August 1941, H. Hoogstraal (CNHM). NAYARIT: Compostela, 16 November 1957, R. and K. Dreisbach (UCD). SANTIAGO IXCUINTLA, 29 July 1953, C. and P. Vaurie (AMNH). SINALOA: Concordia, 700–1000 ft, 4 July 1963, F. Parker and L. Stange (UCD). One headless metatype female from Zacapa, Guatemala, 29 November 1929, D. M. Bates (UCD).

Discussion: This species is most similar to *juncea* Cresson, *dejecta* Cameron and *picipes* Cameron, but the abdominal coloration and pleural hair patterns in both sexes of *aucella* are distinctive. *Ammophila aucella* is known only from Mexico and Guatemala.

***Ammophila bella* Menke, new species**

Holotype male: Length 17.5 mm.

Color: Black; petiole sternite apicoventrally and tergite laterally, red; gastral segments I–II red, tergite I with median black stripe, II



with median black stripe anteriorly, posterior half broadly black; closing face of femoral apex red; wings clear, veins brown.

Vestiture: Gena along outer orbit with appressed silver hair; collar with transverse band of appressed silver hair along posterior margin, scutum with median longitudinal stripe of appressed silver hair; mesopleuron with appressed silver hair, hair densest near mid coxa and lacking ventrally and on hypopleural area; inferior metapleural area with a small patch of appressed silver hair near hind coxa, patch continuous with band of hair on propodeal side of metapleural sulcus, propodeal band extending to superior metapleural pit, hairs perpendicularly oriented to metapleural sulcus; erect body hair long, dense.

Structure: Labrum rounded; collar densely micropunctate, moderately macropunctate; scutum densely micropunctate and macropunctate; scutellum punctate and ridged; mesopleuron, inferior metapleural area and propodeal side densely micropunctate and macropunctate.

Female: Average length 17 mm, range: 15–19 mm.

Color: As in male but tegula and petiole red (petiole sternite sometimes black), gaster red but tergite III black medially and segment IV black; femur, tibia and tarsus of front leg red; mid femur and tibia red; hind femur red.

Vestiture: Appressed hair as in male but denser; erect mesosomal hair very short.

Structure: Labrum rounded; clypeal disk moderately to strongly bulging, densely macropunctate, median free margin strongly projecting; inner orbits moderately converging below; propodeal side rugosopunctate.

Types: Holotype male: 3 mi. N Petlalcingo, Puebla, Mexico, 21 August 1963, F. D. Parker and L. A. Stange (UCD). Forty-seven male and 12 female paratypes as follows: MEXICO, GUERRERO: 24 mi. S Iguala, 18 July 1963, F. Parker and L. Stange (UCD). Mexcala, 29 June 1951, P. D. Hurd (CIS). Zumpango, 22 July 1963, L. Stange and F. Parker (UCD). PUEBLA: 5 mi. S Izúcar de Matamoros, 1 August 1963, L. Stange and F. Parker (UCD). Petlalcingo, 3 August 1963, L. Stange and F. Parker (UCD). 3 mi. N. Petlalcingo, 3 and 21 August 1963, F. Parker and L. Stange (UCD). Tehuacán, 1903, L. Digue (PARIS). SINALOA: Concordia, 4 July 1963, F. Parker and L. Stange (UCD). 8 mi. S Elota, 2 July 1963, F. Parker and L. Stange (UCD). SONORA: 10 mi. W Alamos, 21 July 1954, M. Cazier and W. Gertsch (AMNH).

Discussion: The metapleural hair pattern will separate *bella* from

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FIG. 1, ventral view of male head of *A. imitator*. FIGS. 2–4, male genitalia of *Ammophila coachella* (Fig. 2), *A. imitator* (Fig. 3, a = lateral view, b = dorsal view of aedeagus), *A. mimica* (Fig. 4, a = lateral view, b = dorsal view of aedeagus). FIGS. 5–6, anterior and lateral view, respectively, of male head of *Ammophila coachella*. FIG. 7, lateral view of prothorax of *Ammophila mescalero*.

other red-legged Mexican species such as *mescalero* and *aellos*. *Ammophila bella* is most similar to *bellula*, a species known so far only from Arizona and New Mexico, but the male clypeus is emarginate in the former and the mesosoma has much erect hair. The aedeagus of *bellula* is distinct also. Females of these two species are difficult to separate. The collar in *bellula* is more strongly humped in lateral view and has a slight overhang at the transverse line. The collar in *bella* is shorter. This species is known only from Mexico.

***Ammophila dysmica* Menke, new species**

Holotype male: Length 15 mm.

Color: Black; petiole tergite and gastral segments I-II red with elongate dorsal black spots; wings clear, veins dark brown.

Vestiture: Gena without appressed silver hair; mesopleuron with a band of appressed silver hair along mesopleural suture from base of mid coxa to bottom of hypoepimeral area.

Structure: Labrum obtusely acuminate; collar densely micropunctate, moderately macropunctate; scutal surface rather dull, densely micropunctate, the punctures tending to elongate transversely, moderately macropunctate, furrows transversely rugose; scutellum sparsely punctate, nearly completely ridged; mesopleuron densely micropunctate, moderately macropunctate; inferior metapleural area moderately punctate, interspaces smooth anteriorly becoming roughened posteriorly; propodeal side rugosopunctate.

Female: Average length 18 mm, range: 15-20 mm.

Color: As in male except petiole tergite and gastral segments I-II completely red, tergite III laterally and sternite, red.

Vestiture: As in male with addition of a poorly defined patch of appressed silver hair on inferior metapleural area adjacent to metapleural sulcus near hind coxa; femoral psammophore hairs often brownish.

Structure: Labrum acuminate; clypeal disk moderately bulging, densely micropunctate, sparsely to moderately macropunctate, median free margin projecting, teeth well formed; inner orbits slightly converging below; collar densely micropunctate, sparsely macropunctate; scutum densely micropunctate, the punctures tending to elongate transversely, sparsely to moderately macropunctate, scutal furrows with transverse microridges and a few large rugae; mesopleural surface generally covered by irregular microsculpture, becoming finely, vertically microridged anteriorly, sparsely to moderately macropunctate; inferior metapleural area with irregular microsculpture which tends to form vertical microridges, especially posteriorly, sometimes irregularly rugose, sparsely macropunctate; propodeal side weakly, vertically rugosopunctate with microridges between rugae.

Types: Holotype male: Sagehen Creek near Hobart Mills, Nevada Co., California, 5 July 1962, E. J. Montgomery Parker (UCD). Seventy-five male and 86 female paratypes (CAS, CIS, UCD, LACM, AMNH, CSDA, CUI, USNM, OSU, NSDA) collected from June 4 to August 3, 1909-1964 at the following localities:

CALIFORNIA, ALPINE Co.: Hope Valley. ELDORADO Co.: Angora Lake; China Flat; Echo Lake; Fallen Leaf Lake; Glen Alpine Creek; Lake Tahoe; Strawberry; Strawberry Valley; Tahoe; Tahoe Valley. LASSEN Co.: Bridge Creek Camp; Summit Camp; Westwood. MODOC Co.: Canby; Davis Creek; Straw. NEVADA Co.: Boca; near Hobart Mills; Sagehen Creek near Hobart Mills; Truckee, 7 mi. SE; Upper Sagehen Creek. PLACER Co.: Carnelian Bay. PLUMAS Co.: Blairsden; Bucks Lake; Graeagle; Johnsville. SHASTA Co.: Burney, 5 mi. E; Hat Creek; Hat Creek, 4 mi. S; Moose Camp. SIERRA Co.: Calpine; Gold Lake; Smith Mill, 15 mi. SE Sierraville. SISKIYOU Co.: McCloud, 5 mi. E. TEHAMA Co.: Deer Creek. TRINITY Co.: Coffee Creek. TULARE Co.: Bearpaw Meadow, Sequoia National Park; Hackett Meadow to Shotgun Creek, Sequoia National Park. TUOLUMNE Co.: Dardanelles; Sonora Pass, 9624 ft; Strawberry. NEVADA, WASHOE Co.: Galena Creek. OREGON, BAKER Co.: Wallowa Mountains. DESCHUTES Co.: Bend, 10 mi. W; Century Drive, Bend; Sisters; Tumalo Reservoir. KLAMATH Co.: Lake of the Woods.

Discussion: This species is similar to *kennedyi* and *urnaria*. *A. dysmica* females can usually be separated from these two species by the silver face and minutely roughened pleura. The appressed facial hair of *kennedyi* and *urnaria* females is usually brown. The completely red first gastral tergite of *kennedyi* males will usually separate this species from *dysmica*. The separation of *dysmica* and *urnaria* males is more difficult. Most specimens can be identified on the basis of distribution since the ranges of the two species overlap only along the eastern Rocky Mountains. As far as known, *urnaria* males have red only on gastral segment I, whereas *dysmica* males have red on both I and II. Completely black-legged *parkeri* males can be confused with *dysmica* but the gastral sternites are red in the former.

Ammophila dysmica is known from California, Oregon, Nevada, Idaho, and Colorado.

***Ammophila hermosa* Menke, new species**

Holotype male: Length 17.5 mm.

Color: Black; petiole tergite red laterally, black above; gastral sternites I–IV red, tergite I red with median black stripe, tergite II red, III–IV red laterally; femur red below, black above, front tibia red, middle and hind tibia red below, black above; wings clear, veins black.

Vestiture: Gena along outer orbit with dense appressed silver hair; collar and scutum with sparse silver to brownish appressed hair; scutum with posteromedian stripe of appressed silver hair; mesopleuron largely covered with appressed silver hair, hair densest along mesopleural suture forming a band from mid coxa to top of hypopleural area; inferior metapleural area with a poorly defined patch of appressed silver hair near hind coxa.

Structure: Labrum obtusely acuminate, nearly truncate; collar densely

micropunctate, moderately macropunctate; scutum densely micropunctate, moderately finely macropunctate, shining; scutellum densely micropunctate, sparsely macropunctate anteriorly, ridged posteriorly; inferior metapleural area densely micropunctate, moderately macropunctate; propodeal side densely macropunctate.

Female: Average length 18 mm, range: 15.5–19.5 mm.

Color: As in male except mandibles and clypeal margin sometimes red; pronotum sometimes with small reddish spot just above lateral line; tegula usually red; inferior metapleural area and propodeum red, or only propodeal side red, mesosoma infrequently entirely black; abdomen red, gastral tergites II–IV occasionally with small black spots; femur, tibia and tarsus red.

Vestiture: As in male except pleural bands denser and more clearly defined.

Structure: Labrum rounded but with median projection; clypeal disk slightly bulging, densely micropunctate, moderately macropunctate, free margin produced, teeth well formed; inner orbits very slightly converging below; scutum densely micropunctate, sparsely, finely macropunctate; scutellum smooth, sparsely, finely macropunctate; propodeal side finely rugose.

Types: Holotype male: Black Lake, Mono Co., California, 10 August 1962, L. A. Stange and A. S. Menke (UCD). Twenty-three male and 25 female paratypes as follows: ARIZONA, COCHISE Co.: 7 mi. W Tombstone, 29 November 1963, V. L. Vesterby (UCD). MARICOPA Co.: Granite Reef Dam, 9–22 October 1964, J. M. Davidson (ASU). PIMA Co.: Organ Pipe Cactus National Monument, 16 April 1948, on *Baileya*, A. L. Melander (UCR). Tucson, 1 November 1940, Bryant (CAS). YUMA Co.: Castle Dome Mountains, 31 March 1959, A. S. Menke and L. A. Stange (LACM). Palm Canyon, Kofa Mountains, 8 April 1963, J. Powell and G. Tamaki (CIS). Yuma, 17 September 1952, H. A. Hill (SDM). CALIFORNIA, INYO Co.: Mazourka Canyon, 2 July 1953, on *Salix*, H. Nakakihara (UCR). Westgard Pass, 18 June 1942, R. M. Bohart (UCD). 7 mi. W Westgard Pass, 24–26 June 1953, J. W. MacSwain (CIS). MONO Co.: Black Lake, 10 August 1962, L. A. Stange (UCD). Topaz Lake, 26 June 1957, J. W. MacSwain and J. M. Burns (CIS). RIVERSIDE Co.: Magnesia Canyon, 29 April 1953, J. C. Hall (UCD). SAN DIEGO Co.: Anza State Park, 28 October 1955, T. R. Haig (UCD). COLORADO, BACA Co.: Regnier (AMNH). NEVADA, WASHOE Co.: Gerlach, 28 June 1939, M. A. Cazier (CIS). MEXICO, CHIHUAHUA: Santa Clara Canyon, 5 mi. W Parrita, 6 July 1954, J. W. MacSwain and E. I. Schlinger (CIS).

Discussion: *Ammophila hermosa* can usually be identified by the reddish legs and posteromedian silver scutal stripe. *Ammophila juncea* and *mescalero* are similar but the former has black legs and the latter has a cariniform collar. *Ammophila hermosa* is known only by the types.

***Ammophila mescalero* Menke, new species**

Holotype male: Length 16 mm.

Color: Black; tegula brownish; petiole tergite red laterally, black above; gastral sternites I–III red, tergites I–II red but with elongate median black spots, tergite III red laterally; front and middle femur and tibia red, hind femur, tibia and tarsus largely black; wings clear, veins reddish brown.

Vestiture: Gena with appressed silver hair; collar and scutum sparsely covered with appressed silver hair; scutum with posteromedian longitudinal silver stripe; mesopleuron covered by appressed silver hair, hair densest along mesopleural suture; inferior metapleural area with a patch of appressed silver hair near base of hind coxa, patch crossing metapleural sulcus and extending onto propodeal side as far as propodeal spiracle.

Structure: Labrum truncate; collar strongly cariniform anteriorly, overhanging transverse line (Fig. 7), collar surface densely micropunctate, moderately macropunctate, shining; scutellum punctate, ridged posteriorly; mesopleuron, inferior metapleural area and propodeal side densely micropunctate, densely macropunctate, shining; metapleural sulcus poorly defined.

Female: Average length 17.5 mm, range: 15–18 mm.

Color: About as in male, petiole sometimes all red, gaster red, tergite I with small black spot, III–IV with large black spots; wing veins reddish brown to dark brown.

Vestiture: As in male except mesopleural appressed hair forming a distinct band along mesopleural suture.

Structure: Labrum rounded, sometimes with a median projection; clypeal disk moderately bulging, densely micropunctate, moderately to densely macropunctate, median free margin projecting, teeth well formed; inner orbits moderately converging below; mesosomal sculpture as in male except propodeal side sometimes weakly rugosopunctate.

Types: Holotype male: Cacaloapan, Puebla, Mexico, 26 April 1962, L. A. Stange (UCD). Nineteen male and 7 female paratypes as follows: UNITED STATES, ARIZONA, SANTA CRUZ Co.: 10 mi. E Sonoita, 9 August 1940, E. S. Ross (CAS). COLORADO, BACA Co.: Regnier, 6–9 June 1919 (AMNH). TEXAS, "Texas," Belfrage (USNM). BREWSTER Co.: Alpine, 11 July 1938, L. W. Hepner (UKL). MEXICO, AGUASCALIENTES: Aguascalientes, 18 August 1953, C. and P. Vaurie (AMNH). CHIHUAHUA: 38 mi. S Hidalgo del Parral, 24 October 1957, H. A. Scullen (OSU). JALISCO: Encarnación de Díaz, 28 July 1951, P. D. Hurd (CIS). Lagos de Moreno, 12 August 1954, R. R. Dreisbach (UCD); 19 August 1960, Arnaud, Ross and Rentz (CAS). MEXICO: Teotihuacán Pyramids, 15 June 1951, P. D. Hurd (CIS). OAXACA: Mitla, 3 July 1955, P. and C. Vaurie (AMNH). 8 mi. N Oaxaca, 12 December 1948, E. S. Ross (CAS). PUEBLA: 8 mi. S Puebla, 13 July 1953 (UKL). 49 mi. E Puebla, 7 June 1956, H. A. Scullen (OSU). Tehuacán, 12 July 1935, A. E. Pritchard

(UMSP). QUERÉTARO: 28 mi. E Querétaro, 13 June 1956, H. A. Scullen (OSU). ZACATECAS: 4 mi. N Fresnillo, 20 August 1960, Arnaud, Ross and Rentz (CAS) 15 km E Sombrerete, 30 July 1951, P. D. Hurd (CIS). 55 km marker, highway 45, 3 July 1961, R. R. Dreisbach (UCD). One meta-type female from Oaxaca, Oaxaca, Mexico, 20 April 1947, B. Malkin (AMNH).

Discussion: In the male the petiole sternite varies from black to red and gastral tergite II may be all red. This species is most similar to *hermosa* and *aellos* but the form of the pronotum is distinctive (Fig. 7). *Ammophila mescalero* is known only by the types.

The following two new species belong to the *procera* group which has been defined by Menke (1964).

***Ammophila monachi* Menke, new species**

Holotype male: Length 11.5 mm.

Color: Black; mandible, tegula, subalar area, peritreme, superior metapleural area and flange, and propodeal side red; petiole tergite and gaster red; legs red except coxa, trochanter and femur above; wings clear, veins black.

Vestiture: Gena and pronotal lobe with dense appressed silver hair; pronotal collar and scutum with sparse appressed silver hair; meso- and metapleuron with dense appressed silver hair; erect hair pale and restricted to head.

Structure: Flagellomere I longer than II (29:19), length less than least interocular distance (29:36); shape of collar as in *nearctica* Kohl, surface with many fine microridges; scutum with many fine microridges; propodeal side diagonally ridged; metapleural flange not lamellate.

Female: Average length 12.5 mm.

Color: Red; ocellar triangle, transverse line of pronotum, propodeal enclosure, mesosternal region and inferior metapleural area near hind coxa, black; gastral tergites I-IV with transverse brownish bands; dorsal surface of mid and hind coxa, trochanter and femur, black.

Vestiture: Appressed silver hair restricted to anteroventral region of mesopleuron.

Structure: Clypeal disk moderately bulging, surface sparsely macropunctate, median free margin slightly projecting, teeth absent; flagellomere I longer than II (41:24); inner orbits very slightly converging above; pronotal collar as in male but more evenly arcuate in lateral view; scutal ridges stronger than in male, obliterated along midline; mesopleuron along mesopleural suture smooth, sparsely macropunctate; hypoepimeral area and superior metapleural area with horizontal ridges; propodeal side closely, diagonally ridged, ridges continuous over inferior metapleural area.

Types: Holotype male: Mount Montgomery, 7000 ft, Mineral Co., Nevada, 21 June 1942, R. M. Bohart (UCD). Three male and three female paratypes with same data (UCD).

Discussion: The reddish body is distinctive in female *monachi*. *Ammophila wrightii* Cresson is similar but the pronotum is much flatter than in *monachi*. Males of *monachi* have a narrower face than *wrightii* males and the body of the latter is largely red. *Ammophila monachi* is known only by the types. The name *monachi* is the Yokut Indian word for the Mono Indians.

***Ammophila unita* Menke, new species**

Holotype male: Length 15.5 mm.

Color: Black; metapleural flange brownish; petiole tergite red laterally, black above; gastral segments I–II red, tergites I–II with median black spots; apex of front and middle femur below and front and middle tibia below, red; wings clear, veins black.

Vestiture: Gena, pronotal side, scutal furrows, mesopleuron and metapleuron covered with dense appressed silver hair; collar and scutum sparsely covered with appressed silver hair; erect mesosomal hair pale, sparse, shorter on head.

Structure: Labrum broadly emarginate, emargination V-shaped; clypeal free margin reflexed; flagellomere I longer than II (43:25), length less than least interocular distance (43:48); pronotal collar similar to female *ferruginosa* Cresson except disk slightly more arched in profile, collar surface with about five feeble transverse ridges which do not reach pronotal side, surface otherwise smooth and sparsely finely macropunctate; scutum ridged, interspaces shining, sparsely punctate; propodeal side diagonally rugosopunctate; metapleural flange lamellate, outer margin strongly angulate.

Female: Average length 18.5 mm, range: 18–19 mm.

Color: As in male except mandibles, clypeal free margin, scape frequently, tegula, subalar area frequently, metapleural flange, and propodeum adjacent to petiole socket, red; petiole sternite usually red, gastral tergite I sometimes with narrow black spot, tergites III–IV largely black; legs more extensively red than in male.

Vestiture: As in male but no erect mesosomal hair except occasionally on pronotal collar.

Structure: Labrum truncate; clypeal disk slightly bulging near free margin, surface shining, sparsely macropunctate, median free margin slightly produced, teeth well formed; flagellomere I more than twice length of II (62:28); inner orbits parallel; pronotal collar similar to male except only slightly or not at all cut off anteriorly, surface with a few wrinkle-like ridges or smooth.

Types: Holotype male: Castle Park, Dinosaur National Monument, Moffat Co., Colorado, 30 June 1948, H. G. Rodeck (USNM). Seventeen male and five female paratypes as follows: ARIZONA, COCONINO Co.: Fredonia, 10 October 1954, K. Goodarzy and G. Knowlton (UKL). COLORADO, county unknown: Caisson, 1 July 1931, J. Nottingham (UKL). Red Wash, 29 July 1953, R. R. Dreisbach (UCD). DELTA Co.:

Delta, 25 June 1938, U. Lanham (UCB). LA PLATA Co.: Bondad, 27 June 1919 (AMNH). MOFFAT Co.: Castle Park, Dinosaur National Monument, 30 June 1948, H. G. Rodeck (UCB). Red Rock Ranch, Dinosaur National Monument, 6 July 1949, H. G. Rodeck (UCB). NEVADA, LINCOLN Co.: Panaca, 30 August 1961, F. D. Parker (NSDA). UTAH, BEAVER Co.: Beaver Creek Hills (USNM). DUCHESNE Co.: Roosevelt, 27 July 1953, R. R. Dreisbach (UCD); 29 June 1954, G. Knowlton (UKL). GRAND Co.: Moab, 2 September 1964, F. D. Parker (UCD). MILLARD Co.: Delta, 8 July 1954, G. Knowlton (UKL). UINTA Co.: no locality, 10 July 1911 (CMP). WYOMING, PARK Co.: Buffalo Bill Reservoir, 2 August 1950, R. R. Dreisbach (UCD).

Discussion: Except for the presence of ridges on the collar and slight abdominal color differences this species is very similar to *Ammophila novita* (Fernald). The length of flagellomere I is slightly less than the least interocular distance in *unita* males whereas in *novita* the two measurements are equal. Also, the clypeal free margin is reflexed in *unita* males. Gastral tergites I and III-IV are partially black in *unita* females but in *novita* the gaster is usually all red. The ranges of the two species do not overlap. *Ammophila novita* occurs from southern California to southeastern Arizona. *Ammophila unita* is known only from the Great Basin Region and surrounding areas.

***Ammophila mimica* Menke, new species**

Holotype male: Length 16 mm.

Color: Black; mandible, tegula, metapleural flange, and a spot at side of petiole socket, red; petiole tergite red laterally, black above; gaster red, tergite I with elongate black spot; tergites III-V largely black; femur red apically, front and middle tibiae red, tarsus brownish; wings clear, veins black.

Vestiture: Clypeus, frons and gena with dense appressed silver hair; scutal disk, propodeal enclosure laterally and propodeal side along metapleural sulcus, covered with dense appressed silver hair; head and mesosoma with pale erect hair.

Structure: Labrum truncate; clypeus narrowly emarginate; flagellomere I nearly twice length of II (39:21), length equal to least interocular distance (39:39); pronotal collar abruptly rising at transverse line, disc arcuate, surface of collar smooth, sparsely macropunctate; scutum transversely ridged, interspaces punctate; scutellum longitudinally ridged; propodeal enclosure laterally with diagonal ridges, interspaces shining, impunctate; preepisternal sulcus short, ending opposite pronotal lobe; propodeal side striatopunctate; metapleural flange lamellate, outer margin strongly angled; genitalia as in Fig. 4.

Female: Average length 17 mm, range: 17-18 mm.

Color: As in male except clypeal free margin and gastral tergite V red; scape, pronotal side, mesopleuron, propodeal side, and legs, often extensively red.

Vestiture: As in male.

Structure: Labrum truncate; clypeal disk slightly bulging below, surface shining, sparsely macropunctate, free margin with two teeth, median free margin slightly projecting in relation to lateral free margin; flagellomere I slightly longer than twice length of II (53:26); inner orbits parallel; pronotal collar curving up gradually from transverse line, disk arcuate in lateral view.

Types: Holotype male: Cronise Valley, San Bernardino Co., California, 29 April 1956, on *Prosopis* species, M. Wasbauer (CIS). Nine male and four female paratypes as follows: CALIFORNIA, IMPERIAL Co.: Palo Verde, 15 August 1946, W. F. Barr (CIS). INYO Co.: Furnace Creek, Death Valley, 27 February 1956, R. M. Bohart (UCD). Stovepipe Wells, Death Valley, 30 March 1953, J. W. MacSwain (CIS). RIVERSIDE Co.: Coachella Valley, 17 May 1917, E. P. Van Duzee (CAS); 10 July 1932 (USNM). SAN BERNARDINO Co.: Cronise Valley, 29 April 1956, B. J. Adelson, P. D. Hurd, J. Powell, and M. Wasbauer (CIS). SAN DIEGO Co.: Borrego Valley, 18 April 1957, R. M. Bohart (UCD). Two metatypes: ARIZONA, MARICOPA Co.: Gila Bend, 18 mi. S, 8 May 1965, ♂, M. A. Mortenson, J. M. Davidson, M. A. Cazier (UCD). PIMA Co.: Tucson, 8 mi. N, 5 June 1964, ♀, J. Davidson (UCD).

Discussion: This species appears related to the *procera* group but the male genitalia are unlike the type found in this assemblage. Externally, *Ammophila mimica* is very similar to *novita* (Fernald), and in fact, the females of these two species are very difficult to separate. Flagellomere I usually is slightly more than twice the length of II in female *mimica* but less than twice II in *novita*. Usually *mimica* females have a fair amount of erect hair on the mesosoma whereas in *novita* there is little or none at all. The ranges of the two species overlap to a large extent.

***Ammophila imitator* Menke, new species**

Holotype male: Length 19 mm.

Color: Black; mandible, pronotal lobe, tegula, subalar area, metapleural flange and propodeal side near petiole socket, red; petiole tergite red laterally, black above; gaster red, tergite I with a narrow black spot, tergites III-V with large black spots; femur red below, fore tibia red; wings clear, veins brown.

Vestiture: Clypeus, frons, gena and pronotal lobe covered with dense appressed silver hair; pronotum, and scutum anterolaterally, thinly covered with appressed silver hair; scutal furrows, propodeal enclosure medially, meso- and metapleuron, and propodeal side near petiole socket with dense appressed silver hair, metapleural hair densest along metapleural sulcus; head and collar with erect pale hair.

Structure: Labrum truncate; free margin of clypeus rounded, re-flexed, not emarginate; flagellomere I longer than II (43:26), length less than least interocular distance (43:50); hypostoma sharply elevated at mandible base (Fig. 1); pronotal collar elongate, flattened, abruptly

rising at transverse line, surface smooth except for very slight wrinkling on disk, sparsely macropunctate; scutum coarsely ridged, interspaces punctate; scutellum longitudinally ridged; propodeal enclosure rugose medially, diagonally ridged laterally, interspaces shining; preëpisternal sulcus short, ending opposite pronotal lobe; propodeal side punctostriate anteriorly grading to moderately macropunctate posteriorly; metapleural flange lamellate, outer margin angulate; genitalia as in Fig. 3.

Female: Unknown.

Types: Holotype male: 6 mi. E Douglas, Cochise Co., Arizona, 5 September 1958, on *Haplopappus hartwegi*, P. D. Hurd (CIS). Two male paratypes as follows: MEXICO, SONORA: Alamos, 25 July–7 August 1953, F. S. Truxal (LACM). Cocorit, 23 May 1962, F. D. Parker and L. A. Stange (UCD).

Discussion: *Ammophila imitator* could be placed in the *procera* group if it were not for the peculiar male genitalia and the form of the hypostoma. The species is very similar in most other respects to *novita* (Fernald).

***Ammophila coachella* Menke, new species**

Holotype male: Length 15 mm.

Color: Black; mandible, tegula, and metapleural flange red; petiole red below, black above; gaster red, tergite I with elongate black spot, tergite IV with large black spot and V with small spot; legs largely red but coxa, trochanter and femur black dorsally; wings clear, veins black.

Vestiture: Clypeus, frons, gena, and mesostoma except propodeal enclosure laterally, with dense appressed silver hair which obscures the underlying sculpture; head and mesosoma, except propodeal enclosure, with pale erect hair.

Structure: Labrum truncate; inner tooth of mandible with a raised lamelliform carina (Figs. 5–6); free clypeal margin semicircular, with a median carinate tooth, the carina extending onto clypeal disk (Figs. 5–6); hypostoma with an incurved process at about two-thirds the distance to mandible base, hypostomal carina not evident between projection and mandible (Fig. 6); flagellomere I longer than II (40:25), length less than least interocular distance (40:48); pronotal collar abruptly rising at transverse line, then broadly curving towards scutum, disk irregularly transversely ridged, ridges fading before reaching lateral line; scutum transversely ridged, ridges strongest posteriorly and converging towards scuto-scutellar articulation; scutellum longitudinally ridged; propodeal enclosure laterally with diagonal ridges, interspaces shining, impunctate; preëpisternal sulcus short, ending opposite pronotal lobe; metapleural flange broadly lamellate, outer margin angulate; propodeal side diagonally rugose; right penis valve and gonoforceps as in Fig. 2.

Female: Average length 18.5 mm, range: 17.5–19.5 mm.

Color: As in male except clypeus largely red, scape red and petiole sternite often entirely black.

Vestiture: As in male except clypeus glabrous anteromedially; scutal welts glabrous; psammophore pale.

Structure: Labrum truncate; clypeus moderately bulging near free margin, margin with two weak teeth or angles, median free margin nearly twice width of lateral free margin (69:36); flagellomere I nearly twice length of II (61:34); inner orbits slightly converging above; hypostoma without process near mandible; pronotal collar gradually curving back from transverse line; scutum anterolaterally and furrows, rugosopunctate, area between furrows and median longitudinal sulcus welt-like, shining, sparsely to moderately punctate with a few converging ridges posteriorly.

Types: Holotype male: Boyd Desert Research Center (Deep Canyon), 4 mi. S Palm Desert, Riverside Co., California, 6 April 1963, on *Dalea schottii*, C. A. Toschi (CIS). Fourteen male and four female paratypes as follows: CALIFORNIA, RIVERSIDE CO.: Andreas Canyon near Palm Springs, 10 April 1955, W. R. Richards (CNC). Biskra Palms, 29 March 1957, E. I. Schlinger (UCD). Boyd Desert Research Center, 4 mi. S Palm Desert, 12 April 1963, P. D. Hurd (CIS). Thousand Palms, 23 March 1955, W. R. Richards (CNC); 9 April 1955, W. R. Richards (CNC); 13 April 1955, W. R. Richards (CNC). 6 mi. E Thousand Palms, 20 March 1960, D. P. Gregory (CIS). Willis Palms Oasis, Thousand Palms, 25 March 1955, W. R. Mason (CNC); 3 April 1955, W. R. Richards (CNC); 10 April 1955, W. R. Mason (CNC). SAN DIEGO CO.: Anza State Park, 23 April 1951, R. C. Bechtel (UCD).

Discussion: When *Ammophila nefertiti* was described (Menke, 1964) I included paratypic material from southern California. If I had checked the male genitalia of these southern specimens, I would have discovered that they represented another undescribed species. *Ammophila coachella* is very similar to *nefertiti*, and the only obvious external differences in the males are the form of the mandible and hypostomal process. In *coachella* males the inner tooth of the mandible bears a strongly elevated carina (Fig. 6). The hyposomal process in *coachella* is narrower and more acute than in *nefertiti*. Females of *coachella* can be separated from *nefertiti* females only by the broader median free margin of the clypeus. In *nefertiti* the median free margin is only slightly wider than the lateral free margin (55:45). The ranges of the two species do not overlap. *Ammophila nefertiti* is a western Great Basin species and *coachella* is known only from the southern California deserts.

I have seen one male of *coachella* labelled "Sylvia, Kansas, Oct. 8, 1952, H. A. Hill" (SDM), but suspect an error in labelling is involved.

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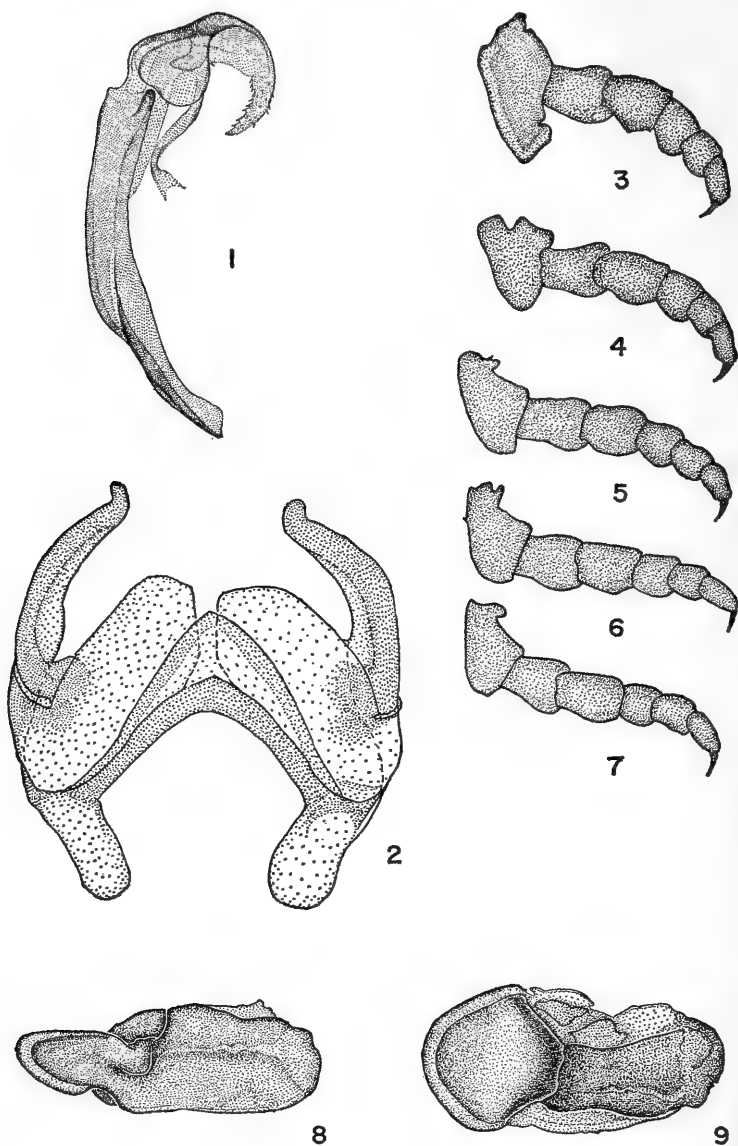
PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

REDISCOVERY AND REDESCRIPTION OF
TYLOBOLUS DESES COOK, WITH THE
DESCRIPTION OF A NEW SUBSPECIES
(DIPLOPODA : SPIROBOLIDAE)

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In December, 1961, a series of ten specimens of *Tylobolus deses* Cook was collected four miles southeast of Petaluma, Sonoma County, California. These specimens were collected beneath old logs of the California Laurel (*Umbellularia californica* Nutt.). The logs were scattered scantily throughout an Oak-Laurel woodland. In the winter of 1964-65, additional specimens of *deses* were collected at various localities in greater central California. These specimens were collected in much the same habitat as the Sonoma County specimens, except for specimens collected in the vicinity of Cordelia, California, which were collected beneath litter composed primarily of the Big Leaf Maple (*Acer macrophyllum* Pursh.), and the Coast Live Oak (*Quercus agrifolia* Neé). With close examination it was found that the specimens collected represented two significantly different subspecies.

To date, no specimens other than those of the type series have been positively identified as *deses* (except for a listing by Buckett, 1964). Thus, the specimens used in this work are the only specimens known in addition to the type series. The Sonoma County specimens cited by Buckett (*op. cit.*) are used in the present work. The only locality data available for the type series of *deses* is "California." Due to the limited locality data available, one cannot accurately evaluate the range of this species. It seems probable that *deses deses* may be restricted to the outer coast ranges of central California, whereas *deses magnificus* Buckett and Gardner, new sub-



FIGS. 1-9, *Tylobolus deses deses*. 1—right posterior gonopod of male, caudal view; 2—anterior gonopods of male, cephalic view; 3-7—caudal views of right pregenital legs of male, legs 3-7, respectively; 8—right cyphopod of female, lateral view; 9—right cyphopod, caudal view.

species, may inhabit only the inner coast ranges of central California.

The 15 specimens composing the type series of *deses deses* were collected by Mr. Carl F. Baker, probably in the vicinity of Palo Alto (teste Cook). Chamberlin (1949) stated for the type-locality: "California: Exact locality not known, but probably either the vicinity of Stanford University or of Claremont." Chamberlin does not indicate where he obtained this information. There is reason to believe that the former is the more probable type-locality as is evidenced by the recent collection of a mature male from Stanford University, in San Mateo County.

Both the gonopods of the male and the cyphopods of the female were dissected, cleared in potassium hydroxide, and stained with lignin pink. The illustrations were prepared by aid of a bioscope, and corrections made by use of a dissecting microscope.

Tylobolus deses deses Cook

Tylobolus deses Cook, 1904. In Harriman Alaska Expedition, 8: 65, pl. 3, Figs. 3 a-h.

Tylobolus deses, Chamberlin, 1949. J. Wash. Acad. Sci., 39: 168.

Tylobolus deses, Chamberlin and Hoffman, 1958. Bull. U. S. Nat. Mus., no. 212, p. 168.

Tylobolus deses, Keeton, 1960. Mem. Amer. Entomol. Soc., no. 17, p. 126.

Tylobolus deses, Buckett, 1964. Simmons Publ. Co., Davis, p. 24.

Males: Total length 44-64 mm (53.5 mm); width 4.0-6.6 mm (5.7 mm); length/width ratio 8.5-11.0 (9.5); number of segments from 42-51 (46); simple eyes per patch 28-36 (30); eye patches separated by $3.5 \times$ width of eye patch; clypeal setae per specimen 8-11 (9.5); labral setae per specimen 12-15 (13.5); stipital setae of gnathochilarium 10-16 (13.1). Collum extending cephalad to eyes, but not covering them; mandibular cheeks and antennal groove also exposed; anterior edge of collum sometimes curving smoothly ventrad, sometimes curving caudad at eyes then ventrad at one half the length of the mandibular cheek. Tergites with numerous striae, reaching to repugnatorial pore on mid-belts, and three-fourths the way between coxae and repugnatorial pore on hind belts. Second segment extending far below ends of collum, heavily sclerotized ventrally, anterior edge sometimes exceeding ventral tip of collum, ventral edge usually curving smoothly posterodorsally, but sometimes produced anteriorly into a laterally flattened lobe. Claw of leg 1 shorter than distal podomere; third pair of legs with coxae greatly

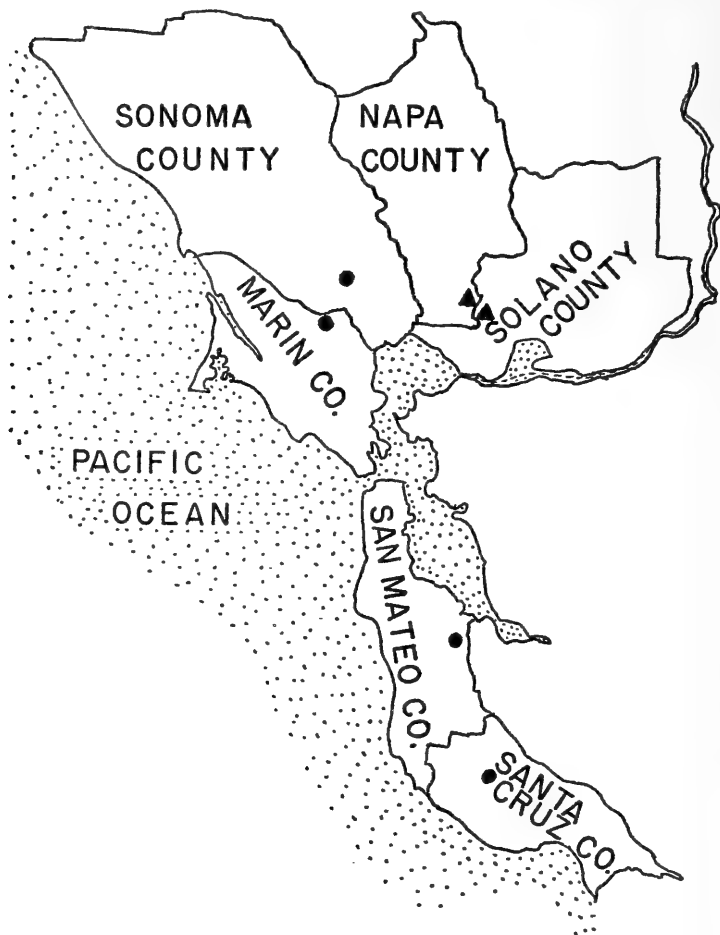


FIG. 10. Distribution of *Tylobolus deses deses* (dots), and *T. deses magnificus* (triangles) in central California.

produced posteriorly, broadly rounded anterolaterally, narrowing posteriorly to vertical ridge, lateroventral surface flattened, a carina ventromesally; coxa of leg 4 rounded laterally, narrowing mesally to vertical ridge; leg 5 with coxa a narrow transverse ridge (narrower than leg 4), slightly broader laterally than mesally, and curving smoothly mesodorsally; legs 5 and 6 with coxae as broadly rounded longitudinally as transversely; podomeres of all legs exhibiting no noticeable lobular processes. Anterior gonopods with distinctly distally uncinat telopodites; coxal endites greatly exceeding apex of sternum mesally, smoothly arching

laterally; posterior gonopods with very long, greatly curved distal process, process spinose nearly to apex; wall of seminal receptacle evenly curved. Anal lips distinct.

Females: Total length 67–70 mm (69 mm); width 8.0–8.6 mm (8.3 mm); length/width ratio 8.1–8.5 (8.3); number of segments from 44–46 (45); simple eyes per patch 32–35 (33.5); eye patches separated by $3.5 \times$ width of eye patch; clypeal setae per specimen 8–11 (9.3); labral setae per specimen 13–14 (13.3); stipital setae of gnathochilarium 12–18 (14.3); remainder of female, except cyphopods, as in male. Cyphopods with basal portion prominently raised; lateral flange much lower than either basal portion or distal lobe when viewed from caudal plane; distal lobe evenly rounded, rising abruptly where it contacts basal portion. Cyphopods as in figures 8 and 9.

T. deses deses is apparently most closely related to *T. castaneus* Chamberlin, as is evidenced most prominently by both the anterior and posterior gonopods of the male. However, if one is to consider the non-swollen podomeres of the pregenital and postgenital legs and the spining of the distal process of the posterior gonopods, *deses* appears to be most closely related to *T. claremontus* Chamberlin. In his original description, Cook compares *deses* with *Hiltonius hebes* (Bollman), which is far removed from *deses*, as we know speciation in the Tylobolinae today.

As can be seen by the illustration of the anterior gonopod, the telopodites distally are distinctly uncinata. Until now, the only complete illustration of the anterior gonopods was presented by Cook (1904) in the Harriman Alaska Expedition. Unfortunately, the data pertaining to *deses*, which is on plate 4, precedes plate 3, and is labeled "plate III," whereas, data for plate 3 precedes plate 4. Apart from this slight bit of confusion Cook's illustration is passable. Keeton (1960) apparently overlooked this error in Cook's work, and thus erroneously cites pl. 3, 3 a–h rather than pl. 4, as it actually should be. The sketch (Fig. 223) of a female cyphopod of one of Keeton's unidentified *Tylobolus* spp. seems to correspond quite well with *deses*.

Male *magnificus* ssp. nov. differ significantly from male *deses* in many characteristics. Student's T Distribution at the 5% level of significance shows that *magnificus* ssp. nov. is longer and wider than the nominate *deses*, possesses more segments, eyes per patch, labral setae, and stipital setae of the gnathochilarium. For exact numerical evaluation, see Table 1. The authors possess only three female specimens of the nominate *deses*; therefore, meaningful statistical analysis of interpopulational differences could not be carried out for that sex.

***Tylobolus deses magnificus* Buckett and Gardner, new subspecies**

Holotype male: Total length 65 mm; width 7.3 mm; length/width ratio 8.9; total number of segments 47; eyes 38 right + 41 left; clypeal setae 10; labral setae 15; stipital setae of gnathochilarium 18; collum extending cephalad to eyes but not covering them; mandibular cheeks

and antennal groove exposed; anterior edge of collum curving caudad at eyes, then ventrad at one-half the length of mandibular cheek; tergites with numerous striae, reaching to repugnatorial pore on mid-belts, and three-fourths the way between coxae and repugnatorial pore on hind belts; second segment heavily sclerotized ventrally, anterior margin extending ventrad from, and far exceeding apex of collum; claws shorter than adjoining distal podomere; legs 3 and 4 with podomeres 1 and 2 slightly lobed; legs otherwise as in the nominate *deses*. Gonopods similar to the nominate *deses*; anal lips less distinct than in the nominate *deses*.

Allotype female: Total length 75 mm; width 8.4 mm; length/width ratio 8.6; total number of segments 46; eyes 33 right + 36 left; clypeal setae 9; labral setae 14; stipital setae of gnathochilarium 14. Much larger and lighter in coloration than male. For range of variation in this sex, see Table 1.

TABLE 1. Data for *T. deses deses* (A); data for *T. deses magnificus* (B); 95% confidence limits for mean of population, based on mean of sample and size of sample (CLM); number of clypeal setae per specimen (CS); number of eyes per patch (E/P); length of specimen (L); mean of of labral setae per specimen (LS); length-width ratio (L/W); mean of sample (M); range of data (R); standard deviation of sample (SD); number of segments (Seg); stipital setae of gnathochilarium (SS); greatest width of specimen (W). Neither the confidence limits of the mean nor the standard deviation was calculated for the females of *deses deses* because of inadequate material.

| MALES | | | | | | | | |
|---------|------|------|----------|----------|-----------|-----------|-------|-------|
| | M | | R | | CLM | | SD | |
| | A | B | A | B | A | B | A | B |
| L | 53.5 | 60.0 | 44-64 | 47-68 | 49.1-57.9 | 56.8-63.2 | 1.96 | 1.52 |
| W | 5.7 | 6.7 | 4.0-6.6 | 5.8-7.4 | 4.5-6.9 | 5.7-7.7 | 0.565 | 0.455 |
| L/W | 9.5 | 9.0 | 8.5-11.0 | 7.6-10.3 | 9.0-10.0 | 8.6-9.4 | 0.277 | 0.171 |
| Seg | 46.0 | 47.5 | 42-51 | 42-51 | 44.8-47.2 | 46.6-48.4 | 0.57 | 0.44 |
| E/P | 30.0 | 38.0 | 28-36 | 29-53 | 28.0-32.0 | 36.4-39.6 | 0.97 | 0.82 |
| CS | 9.5 | 9.6 | 8-11 | 8-12 | 8.8-10.2 | 9.0-10.2 | 0.312 | 0.282 |
| LS | 13.5 | 14.8 | 12-15 | 12-18 | 12.5-14.5 | 14.1-15.5 | 0.453 | 0.340 |
| SS | 13.1 | 14.6 | 10-16 | 12-17 | 12.0-14.2 | 13.6-15.6 | 0.48 | 0.46 |
| FEMALES | | | | | | | | |
| L | 69.0 | 77.5 | 67-70 | 65-90 | 73.5-81.5 | | 1.86 | |
| W | 8.27 | 8.55 | 8.0-8.6 | 7.0-10.0 | 8.12-8.98 | | 0.202 | |
| L/W | 8.33 | 9.1 | 8.1-8.5 | 8.2-10.2 | 8.8-9.4 | | 0.15 | |
| Seg | 45.0 | 47.0 | 44-46 | 44-51 | 46.1-47.9 | | 0.44 | |
| E/P | 33.5 | 35.7 | 32-35 | 30-41 | 34.7-36.7 | | 0.485 | |
| CS | 9.3 | 9.4 | 8-11 | 8-12 | 8.9-9.9 | | 0.257 | |
| LS | 13.3 | 13.9 | 13-14 | 12-16 | 13.2-14.6 | | 0.327 | |
| SS | 14.3 | 16.0 | 12-18 | 10-23 | 14.0-18.0 | | 0.92 | |

Holotype male: 2 mi. W Cordelia, Solano County, California, 25 November 1964 (J. S. Buckett), deposited in the Entomology Collection, Department of Entomology and Acarology, University of California, Davis, California. One paratype (designated allotype), data same as holotype, deposited in the collection of the authors. Additional paratypes deposited in the following institutions or collections: Buckett-Gardner Collection, Davis, California; California Academy of Sciences, San Francisco; N. B. Causey Collection, Baton Rouge, Louisiana; R. L. Hoffman Collection, Radford, Virginia; W. T. Keeton Collection, Cornell University, Ithaca, New York; H. F. Loomis Collection, Miami, Florida; United States National Museum, Washington, D. C. Total number of specimens examined was 34, 33 of which are designated paratypes. Specimens examined: 4 males, 4 females, 2 mi. W Cordelia, Solano County, California, 25 November 1964 (J.S.B.); 8 males, 9 females, 2 mi. W Cordelia, Solano County, 21 December 1964 (J.S.B. and M. R. Gardner); 7 males, 2 females, 3.6 mi. SW Cordelia, Solano County, 27 November 1964 (J.S.B. and W. R. Bauer).

T. deses magnificus can readily be distinguished from the nominate *deses* by its conspicuously larger size; coloration is generally similar except for the broader red annulus on the posterior portion of each segment (giving a bicolored effect in light colored females). Other characteristics are enumerated in Table 1.

The habitat in which *magnificus* occurs is, in general, very similar to that in which the nominate *deses* occurs. The only obvious geographical boundary that might account for isolation of *magnificus* is the drainage of both the Napa and Sonoma rivers, which have wide valleys throughout their latter portions. *T. deses* is confined to woodland, unlike, for example, *T. uncigerus* Wood, which inhabits both woodland and the grassland areas far from woodland. There is not a continuous woodland from Cordelia to Petaluma, unless one goes to the north of the aforementioned valleys, in which case the soil changes radically (to serpentine) in areas, and the flora also undergoes change from lower Sonoran to upper Sonoran and Transition zones. Attempts to collect specimens of *deses* between the two populations have failed.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

FIRST RECORD OF THE PIGMY SHREW IN WYOMING
AND DESCRIPTION OF A NEW SUBSPECIES
(MAMMALIA : INSECTIVORA)

BY L. N. BROWN

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While trapping shrews in the Medicine Bow Mountains of southeastern Wyoming, I took several specimens of the pigmy shrew (*Microsorex hoyi* Baird). Two males were captured during the early fall of 1963 and five females were taken during the summer of 1964. These specimens are as follows: #K-307, adult male, 80-28-9, 30 September 1963; #K-315, adult male, 78-28-9, 2 November 1963; #K-420, adult female, 78-25-9, 17 July 1964; #K-423, adult female, 87-31-9, 21 July 1964; #K-451, juvenile female, 77-26-9, 30 July 1964; #K-471, adult female, 85-28-10.5, 20 August 1964; #K-472 adult female, 87-29-9.5, 24 August 1964. As far as can be determined, these specimens represent the first valid records of the genus *Microsorex* in Wyoming. The trapping locality is at Trail's Divide Pond, ¼-mile south of the University of Wyoming Summer Science Camp on State Highway 130, Centennial, Albany Co., Wyoming. Gallon cans were buried in a boggy area of sphagnum moss and sedge bordering the pond on 20 September 1963. This area is surrounded by a relatively dry stand of Engelmann Spruce (*Picea engelmannii*) and alpine fir (*Abies lasiocarpa*). The elevation of the pond and bog is exactly 10,000 feet above sea level.

The nearest record of *Microsorex* is from a locality 41 miles west of Ft. Collins, Larimer Co., Colorado, recently reported by Pettus and Lechleitner (1963: 119). This is approximately 60 air miles southeast of the Wyoming locality and in the same range of mountains. The Colorado specimens were recorded

in a strikingly similar habitat, *i.e.*, a sphagnum bog bordering a small pond. It is significant to note that these Wyoming and Colorado *Microsorex* populations occur over 500 miles south of the nearest marginal records of the genus in eastern South Dakota and in northwestern Montana. As Pettus and Lechleitner (*Ibid.*) suggested, there is probably a small relict population of *M. hoyi* in the central Rocky Mountains. However, intensive collecting on certain high mountain habitats of central and northern Wyoming and southwestern Montana might reveal additional disjunct *Microsorex* populations along the backbone of the Rockies.

Other small mammals taken in the cans were *Clethrionomys gapperi* (Vigors), *Microtus montanus*, (Peale), *Sorex cinereus* (Kerr), and *Sorex vagrans* (Baird). The wood frog (*Rana sylvatica* (Baird)) was also very numerous in the cans. This is a relict frog population, whose geographical range is similar to that of *Microsorex*.

Comparison of *Microsorex hoyi* from the central Rockies with specimens of *M. hoyi washingtoni* (Jackson) from Montana and *M. hoyi hoyi* from Manitoba revealed that a hitherto unrecognized subspecies occurs in Colorado and Wyoming. The new form may be recognized by the following description:

***Microsorex hoyi montanus*, new subspecies**

Holotype: Adult male (skin and skull), University of Wyoming Museum of Zoology no. K-307; from edge of Trail's Divide Pond, ¼ mi. S of Univ. Wyoming Summer Science Camp on State Highway 130, Centennial, Albany Co., Wyoming; collected by Larry N. Brown, 30 September 1963. (The holotype will be sent to the U.S. National Museum for deposit.)

Distribution: Known from the Medicine Bow Mountain Range of Albany Co., Wyoming and Larimer Co., Colorado.

Diagnosis: Distinguished from *M. hoyi washingtoni* by having summer pelage more gray-brown dorsally, tail darkened toward tip, and ventral pelage pale gray with a moderate buff tinge; skull shorter and more flattened, and palate shorter. Differs from *M. hoyi hoyi* by having a darker and more gray dorsal pelage, tail sepia above instead of buff brown, and the ventral pelage with a moderate buff tinge; skull shorter and narrower, and palate shorter.

Measurements (in mm): Holotype: Total length, 80; tail, 28; hind foot, 9; condylobasal length of skull, 13.6; palatal length, 4.7; cranial

breadth, 6.2; interorbital breadth, 3.0; maxillary breadth, 4.0; maxillary tooth row, 4.6; height of cranium, 3.6.

Average and extreme body and cranial measurements of 10 adults from Albany Co., Wyoming and Larimer Co., Colorado, are: Total length, 82.5 (75–87); tail, 28.0 (25–31); hind foot, 9.3 (9.0–10.5); condylobasal length of skull, 13.4 (13.2–13.6); palatal length, 4.7 (4.6–4.8); cranial breadth, 6.1 (6.0–6.2); interorbital breadth, 3.0 (3.0–3.1); maxillary breadth, 3.9 (3.9–4.0); maxillary tooth row, 4.6 (4.5–4.7); height of cranium, 3.7 (3.6–3.8).

Comparisons: The new form, *M. h. montanus*, has been compared directly with specimens of *M. h. hoyi* and *M. h. washingtoni*, which are the two subspecies with geographical ranges most closely approaching this relict population. The average cranial measurements of three adult *M. hoyi washingtoni* from Montana are: condylobasal length, 14.0; palatal length, 5.3; cranial breadth, 6.8; interorbital breadth, 3.2; maxillary breadth, 4.1; maxillary tooth row, 4.7; height of cranium, 4.2. The average cranial measurements of three adult *M. hoyi hoyi* listed by Jackson (1928: 203) are: condylobasal length 14.7; palatal length, 5.3; cranial breadth, 6.5; interorbital breadth, 3.1; maxillary breadth, 4.3; maxillary tooth row, 4.8.

Remarks: The reduction of buff pigmentation in the dorsal pelage of *M. h. montanus*, together with smaller overall skull dimensions, readily separates this form from its closest geographic relatives. *M. h. montanus* appears to be more closely related morphologically to *M. h. washingtoni* than to *M. h. hoyi*.

Specimens examined: *Microsorex hoyi hoyi*—2 (Univ. Wyoming Museum of Zoology), MANITOBA. *Microsorex hoyi washingtoni*—3 (Montana State Univ. Museum of Zoology), Yellow Bay, Flathead Lake, MONTANA. *Microsorex hoyi montanus*—6 (Colorado State Univ. Museum of Zoology), 41 mi. W Ft. Collins, COLORADO; 7 (Univ. Wyoming Museum of Zoology), ¼ mi. S Univ. Wyoming Summer Science Camp, Centennial, WYOMING (type-locality).

Acknowledgments: I wish to thank R. R. Lechleitner and D. Pettus of the Zoology Department, Colorado State University, Ft. Collins, Colorado for allowing me to examine specimens of *M. hoyi montanus* in their care. I also would like to acknowledge the loan of specimens of *M. hoyi washingtoni* by P. L. Wright of the Department of Zoology, Montana State University, Missoula, Montana.

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PROCEEDINGS
OF THE
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A PSELAPHID BEETLE FROM THE
GALÁPAGOS ISLANDS
(COLEOPTERA : PSELAPHIDAE)¹

BY ROBERT O. SCHUSTER AND ALBERT A. GRIGARICK

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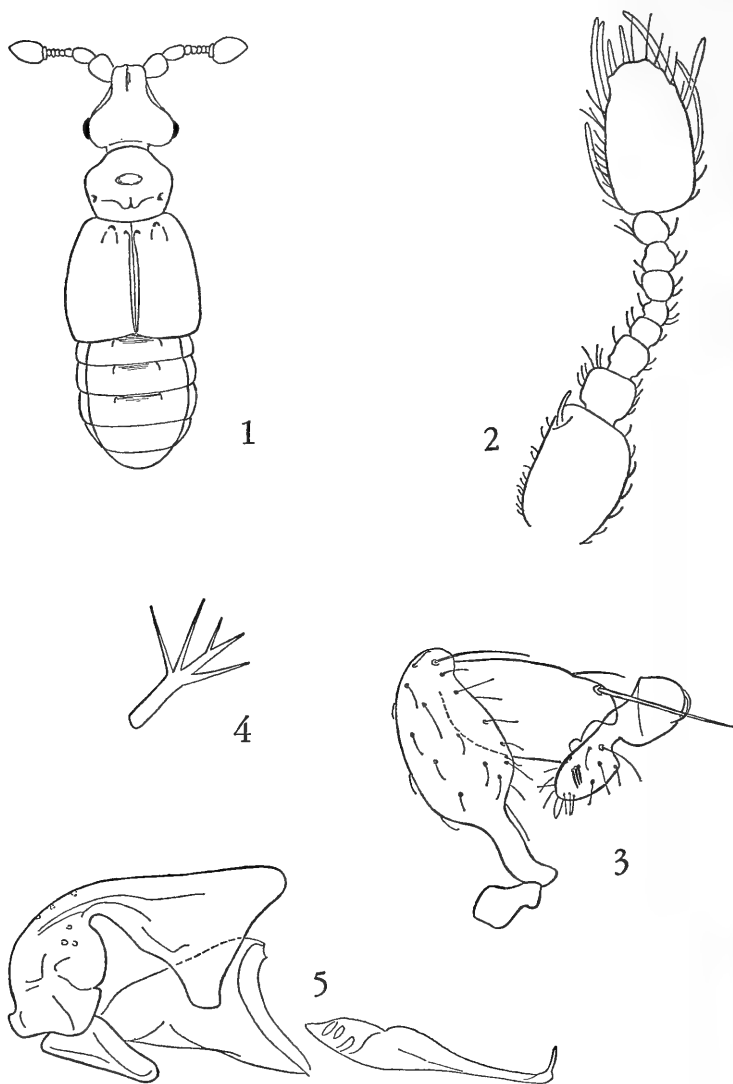
A single specimen of the beetle family Pselaphidae was collected during the University of California's Galápagos International Scientific Project.² It represents the first record of the family in the Galápagos Islands. The individual is a male of *Bythinoplectus*, a genus having few species known from the West Indies and the continental Americas.

Bythinoplectus peregrinus Schuster and Grigarick, new species

Male: Yellowish-brown (Fig. 1), vestiture acuminate except in limited abdominal areas. Head from tempora to clypeus 200μ long \times 295μ wide (including eyes); vertexal foveae small, 8μ to 10μ in diameter, positioned anterior to front margin of eyes, separated by 87μ , and each 87μ from nearest eye margin; apodemes extend from each vertexal fovea to 1 of 2 gular foveae, with a second apodeme connecting each gular fovea and an undefined location on side of head anterior to eyes; eyes of about 45 facets; frontal area with shallow longitudinal depression between antennal tubercles (typical of the female of most other species). Antenna of 9 segments (Fig. 2); segment I with straight anterior margin and single large specialized seta ventrally in subapical area, posterior margin gently rounded; segment II subquadrate; flagellar segments essentially similar except for larger, distinctly conical segment VIII; segment IX with about 10 large lamelliform setae additional to normal setae; approximate measurements are: Segment I $100\mu \times 77\mu$, II $47\mu \times 47\mu$, III $23\mu \times 30\mu$, IV $23\mu \times 26\mu$, V $20\mu \times 26\mu$, VI $23\mu \times 30\mu$, VII $23\mu \times 34\mu$, VIII $26\mu \times 40\mu$, IX $118\mu \times 80\mu$. Maxillary palpus (Fig. 3) with segment I pentagonal, $34\mu \times 24\mu$; II slender in basal $\frac{1}{3}$, abruptly expanded distally, $144\mu \times 44\mu$, with 1 very long seta distally; III $100\mu \times 54\mu$, with a very long subapical seta and a sharp median distal tooth; IV $94\mu \times 37\mu$, constricted medianly, with palpal cone 43μ long. Mandibles curved, acute distally,

¹ Contribution no. 23 from the Charles Darwin Foundation.

² With support of National Science Foundation, grant GE 2370.



Bythinoplectus peregrinus, new species. FIG. 1, dorsal aspect excluding legs; 2, antenna; 3, maxillary palpus; 4, dichotomous abdominal setae; 5, aedeagus in lateral aspect.

with 2 teeth on right and 3 teeth on left ramus, outer margins setate in basal half. Pronotum 235μ long \times 265μ wide; disc transversely impressed; antebasal sulcus medianly interrupted by longitudinal carina. Elytra 320μ long, bifoveate, with sutral stria entire. Winged. Abdomen with visible tergites I–III basally carinate, the enclosed depressions bearing setae dichotomously branched in apical half (Fig. 4); sternites II and III depressed anteriorly each side of middle, the depressions with dichotomous setae. Total length of aedeagus (Fig. 5) 250μ .

Holotype male, Isla Santa Cruz, 4 February 1964, in berlese extract from rotting wood and damp soil, collected on the old trail to Bella Vista, above the barranca at about 90 m, R. O. Schuster. The type is deposited at the Department of Entomology, Davis.

In Park's (1952) key to the Neotropical species this species comes closest to *B. nocturnal*is Park but shows no affinity further than the reduced vertexal foveae. The shape of the aedeagus is distinct from that of additional species described from Honduras by Becker and Sanderson (1953).

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PROCEEDINGS
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THE WEST INDIAN BLENNIID FISHES OF THE
GENUS *HYPLEUROCHILUS*, WITH THE
DESCRIPTION OF A NEW SPECIES

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The Atlantic blennioid fish genus *Hypleurochilus* Gill is characterized by having the gill membranes broadly joined to the isthmus (the gill opening ends at level of lower base of the pectoral), a prominent incurved canine tooth on the side of each jaw posterior to the row of incisiform teeth, typically 14 pectoral rays, and supraorbital cirri. It has been previously known from the western North Atlantic by the type-species, *Blennius multifilis* Girard (which is generally regarded as a junior synonym of *B. geminatus* Wood) and *H. bermudensis* Beebe and Tee-Van.

Recent collections in the Gulf and Caribbean region have revealed two additional species allied to *bermudensis*, sharing with it the deeply indented dorsal fin (last dorsal spine usually less than half the length of the first dorsal ray) and the count of I,4 pelvic rays.¹ One of these fishes is *H. aequipinnis* (Günther) heretofore known only from a single specimen collected in West Africa in 1851. The other represents an undescribed species. Both occur in the West Indies and are treated in the present paper as a prerequisite to a book on the fishes of this region which is in preparation by the writer.

Hypleurochilus geminatus is characterized by a slightly indented dorsal fin (last dorsal spine more than two-thirds length of first dorsal ray) and in usually having I, 3 instead of I,4 pelvic rays. More than one species of blenny is currently

¹ The pelvic spine is small and difficult to see without dissection; the third and fourth rays are slender and easily overlooked.

classified under the name *geminatus*, and a review of this complex is needed. Species of the *geminatus* group in the western Atlantic appear to be confined to continental waters.

As indicated by Norman (1943), *Blennius fissicornis* Cuvier and Valenciennes from Rio de Janeiro appears to be a valid species of *Hypleurochilus*. It is characterized by 1,3 pelvic rays, 14 or 15 dorsal soft rays, 16 or 17 soft anal rays, the last dorsal spine about half the length of the first dorsal ray, and a dark spot anteriorly on the dorsal fin. The elongate supraorbital cirrus of mature males is unusually long, its length contained about 1.6 times in the head length. Specimens from Rio de Janeiro and Montevideo were sent on loan from the British Museum (Natural History). A related species from West Africa, *Hypleurochilus bananensis* (Poll), is discussed briefly in the account of *H. aequipinnis*.

Longley and Hildebrand (1941) have pointed out three morphological differences between the sexes of *H. bermudensis*. The supraocular cirri are dissimilar in the male; one is thick and elongate, exceeding the eye diameter in length. The canine teeth are larger in the male. There are marked differences in the external genitalia (figured on Plate 31 in Longley and Hildebrand). The two anal spines of the male are conspicuously tipped with rugose, fleshy knobs; in the female there is a triangular fleshy region in which the first anal spine is so deeply buried that only its tip shows as a small papilla. These sexual differences are also apparent on at least some of the related species.

The number of incisiform teeth, lateral-line pores and supraorbital cirri of species of *Hypleurochilus* seem to increase with age. These characters have systematic value only when the lengths of specimens are given with the counts. All length measurements in this paper are standard length.

For loans and information on specimens I am indebted to M. L. Bauchot of the Muséum National d'Histoire Naturelle (MNHN); James E. Böhlke of the Academy of Natural Sciences of Philadelphia (ANSP); Fernando Cervigón of the Estación de Investigaciones Marinas de Margarita (Venezuela) (MHNLS); Warren C. Freihofer of the Division of Systematic Biology of Stanford University (SU); Carter R. Gilbert of the

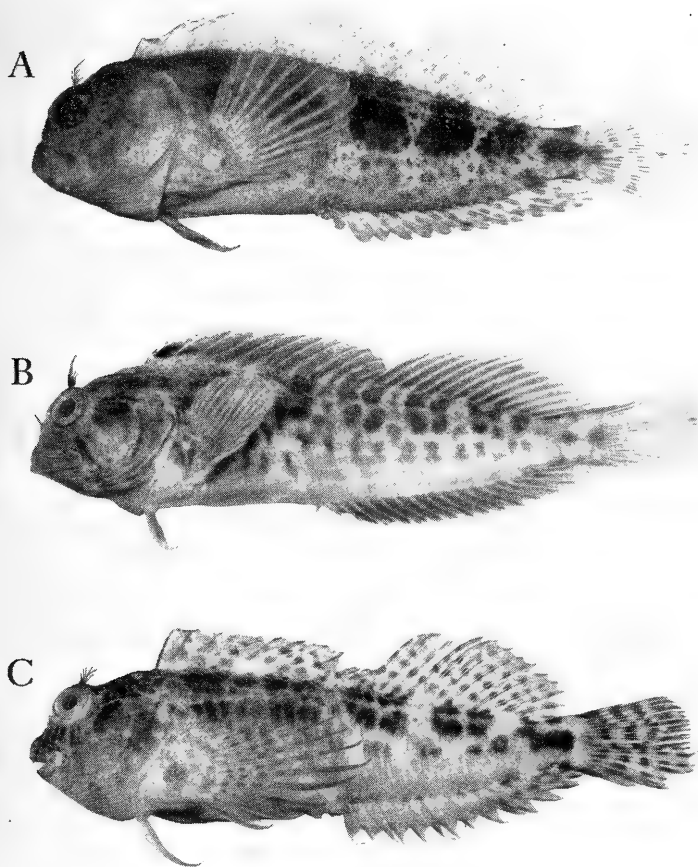


FIG. 1. A.—*Hypleurochilus bermudensis* Beebe and Tee-Van, male, 47.8 mm standard length, Tortugas, Florida (USNM 116805). B.—*Hypleurochilus aequipinnis* (Günther), male, 40.4 mm standard length, Florida Keys (UMML 3131). C.—Holotype of *Hypleurochilus springeri*, female, 48.2 mm standard length, Puerto Rico (USNM 257884-F1).

Florida State Museum, University of Florida (UF); Werner Ladiges of the Zoologisches Staatsinstitut und Zoologisches Museum (ZSZM); Francisco Mago-Leccia of the Museo de Biología, Universidad Central de Venezuela (MBUCV); M. Poll of the Musée Royal de l'Afrique Centrale (Belgium); C. Richard Robins of the Institute of Marine Science, University

of Miami (UMML); Victor G. Springer of the Division of Fishes, U. S. National Museum (USNM); A. C. Wheeler of the British Museum (Natural History) (BMNH); Loren P. Woods of the Chicago Natural History Museum (CNHM) and Ralph W. Yerger and Robert F. Christensen of the Department of Biological Sciences of Florida State University (FSU). Special thanks are due Victor G. Springer for providing vertebral counts and other data from many specimens and for reviewing the manuscript.

Hypleurochilus bermudensis

Fig. 1A

Hypleurochilus bermudensis Beebe and Tee-Van, 1933, *Zoologica*, vol. 13, no. 7, p. 155, Fig. 38 (type-locality, Marshall Island, Bermuda).

Material examined: BERMUDA: USNM 21979 (80.0 mm), no further collecting data; CNHM 48817 (26.0 mm), Flatts Inlet, L. L. Mowbray, 26 November 1927; CNHM 48709 (65.1 mm), Harrington Sound, L. L. Mowbray, 20 June 1934; CNHM 49041 (2: 32.0 and 34.6 mm), White Flatts, L. L. Mowbray, 8 December 1938; UNITED STATES, FLORIDA: USNM 116805 (9: 35.0–47.3 mm), Tortugas, W. H. Longley, no collecting date; UMML 2561 (23.4 mm), 200 ft E Alligator Reef Light, Florida Keys, in 8 to 10 ft, W. A. Starck, II, 14 June 1956; UF 5699 (22.2 mm), jetties at Panama City, Gulfarium staff, October 1956; UMML 4050 (27.6 mm), $\frac{3}{4}$ mi. E Lower Matecumbe Key, Florida Keys, ballast stones in 8–15 ft, C. R. Robins, V. Walters, W. R. Courtenay, and W. A. Starck, II, 3 May 1958; UMML 4658 (32.9 mm), $\frac{1}{2}$ mi. SW Alligator Reef Light, Florida Keys in 20 ft, W. A. Starck, II, 24 August 1958; UMML 5520 (28.4 mm), Alligator Reef Light, Florida Keys, 20 ft, W. A. Starck, II, 13 June 1959; UMML 5486 (37.9 mm), Indian Key, 1 mi. off lower Matecumbe Key, Florida Keys, oolite formation, W. R. Courtenay, W. A. Starck, II, and T. W. McKenney, 19 September 1959; UF 10877 (30.3 mm), Looe Key, $4\frac{1}{2}$ mi. SSW U. S. Highway 1 from Little Torch Key, Florida Keys, C. R. Gilbert and R. Parks, 1–2 November 1963; BAHAMAS: ANSP 93079 (36.0 mm), off Water Cays, Cay Sal Bank, Capt. H. P. Brown, 22 May 1960.

Diagnosis: Pelvic rays I,4; dorsal soft rays 13 (rarely 12); anal soft rays 15 (rarely 14); vertebrae 31 (rarely 30); dorsal fin deeply indented at end of spinous portion; length of pectoral fin contained 3.5 to 4 times in standard length; supraorbital cirri 2 to 7 (usually 4 or 5) in size range of 22 to 80 mm standard length; a series of 6 large roundish to quadrangular saddle-like blotches on upper half of body (sometimes extending narrowly below mid-line); blotches tend to broaden ventrally toward mid-line and may be confluent there; intervening pale areas and ventral half of body with numerous small dark spots; fins with small dark spots (mostly along the rays), those in caudal forming about 4

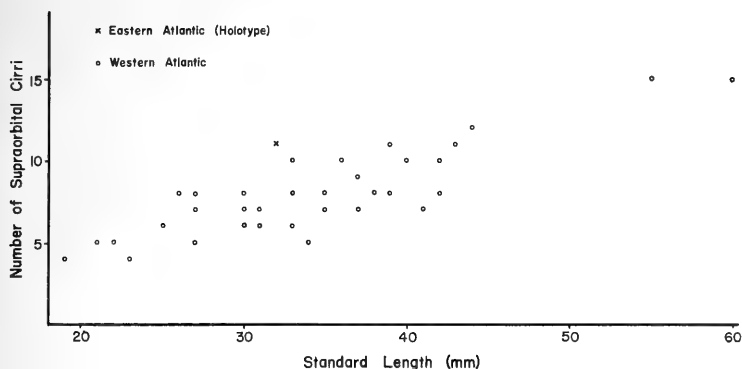


FIG. 2. Relationship of the number of supraorbital cirri of specimens of *Hypleurochilus aequipinnis* to the standard length.

irregular vertical bars; a dark spot centered on caudal base; no dark spot anteriorly on dorsal fin.

Remarks: *H. bermudensis* was described from a single 40-mm Bermuda specimen. Mead (1958) reported that the type is located at the Museum of Comparative Zoology at Harvard University (MCZ 33070). Longley and Hildebrand (1941) recorded the species from Tortugas, Florida. Recent collections here reported for the first time include specimens from Cay Sal Bank in the Bahamas, the Florida Keys, and Panama City, West Florida. Judging from the few specimens in large collections, the species is not common.

Hypleurochilus aequipinnis

Fig. 1B

Blennius aequipinnis Günther, 1861, Cat. Fishes British Mus., vol. 3, p. 225 (type-locality, West Africa).

Material examined: JAMAICA: USNM 131303 (3: 21.0–29.2 mm), "Albatross," 1–11 March 1884; LACM 6485 (25.4 mm), same data as preceding; S CUBA: ZSZM uncatalogued (32.5 mm), Capt. Kreck, 1892; VIRGIN ISLANDS: USNM 78159 (6: 22.7–36.0 mm), C. R. Shoemaker, 10 July 1915; PUERTO RICO: USNM 120341 (43.0 mm), Mayaguez, C. J. D. Behrens, 5 July 1942; UPR 2303 (2: 27.2 and 34.0 mm), TMT dock, Isla Grande, San Juan, mud bottom at edge of concrete ramp in 2–10 ft, J. E. Randall and A. B. Cochran, 10 August 1964; UPR 2372 (3: 22.0–41.6 mm), Magueyes Island, La Parguera, west side at dock, metal debris on silt bottom near *Thalassia* in 8 ft, J. E. and R. D. Randall, 7 November 1964; MNHN 1965–292 (3: 24.9–40.2 mm), Montalva Bay, mangrove islet at east side of bay, mangrove roots in 2–4 ft, D. S. Erdman, 24 February 1965; DOMINICAN REPUBLIC: USNM 88988 (39.8 mm), Samana Bay, G. S. Miller, 22 February 1928;

CURAÇAO: SU 23256 (3: 22.9–26.0 mm), Spanish Water, Dr. van der Horst, 25 May 1920; VENEZUELA: MHNLS 874 (40.8 mm), Gulf of Cariaco, F. Yepez, 28 December 1945; MBUCV V-1936 (24.5 mm), Dos Mosquises, Archipiélago Los Roques, T. Cobo and F. Weibezahn, 5 August 1963; MHNLS 877 (3: 33.0–47.3 mm), Isla Cubagua, near Isla de Margarita, edge of patch reef of *Acropora palmata* at east end of island in 3 ft, J. E. Randall and B. Endicott, 23 January 1965; MBUCV V-2710 (3: 39.5–48.6 mm), Adaro Bay, Paraguaná, NW corner of bay, rock and sand shore in 4 ft, J. E. Randall, 29 January 1965; MEXICO: YUCATAN: USNM 192341 (2: 26.7 and 31.4 mm), Daiber, 20 April 1960; USNM 192400 (2: 30.2 and 35.1 mm), Bredin Expedition, 13 April 1960; USNM 192242 (2: 41.5 and 42.0 mm), Allen Point, Ascension Bay, Bredin Expedition, 12 April 1960; UNITED STATES: FLORIDA: UMML 2626 (29.1 mm), Bear Cut, Virginia Key, Miami, D. P. de Sylva, September 1955; UMML 3131 (11: 19.1–40.4 mm), Barnes Sound, 1.5 mi. N Jewish Creek Bridge by U. S. Highway 1, Florida Keys, C. R. Robins, W. Courtenay, R. Cissel, and W. Yang, 25 June 1957; UMML 4072 (11: 26.8–59.9 mm), pier of Marine Laboratory, University of Miami, Virginia Key, W. R. Courtenay and A. J. Provenzano, 4 March 1958; UMML 4625, same locality as UMML 4072, Diva Correa, 14 January 1959; ANSP 93078 (36.9 mm), northern end of Key Largo, Florida Keys (25° 18' 35"N, 80° 16' 30"W), bottom largely coral mud and heavy grass, D. M. and A. N. Barringer and L. and C. Dam, 3 April 1958; FSU 12242 (32.4 mm), Jupiter Inlet, Palm Beach County, Susan Kindt, September–November 1958; FSU 12082 (31.5 mm), same locality as FSU 12242, Flora Hodgson, 17 February 1959; FLORIDA: Fort Pierce, USNM 103115 (32.7 mm), Christianson and Behrens, 13 January 1937.

Diagnosis: Pelvic rays I,4; dorsal soft rays 13 or 14; anal soft rays 15 or 16 (rarely 14); vertebrae 32 (rarely 31 or 33); dorsal fin deeply indented; pectoral fin contained 3.6 to 4.3 times in standard length; supraorbital cirri 4 to 15 in size range of 20 to 60 mm standard length (Fig. 2); upper half of body with a series of 6 groups of dark spots, each group consisting of 4 spots or aggregates of spots arranged approximately in a square; first group of spots centered at base of third and fourth dorsal spines, third group beneath notch of dorsal fin, fourth centered beneath base of fourth dorsal soft ray, and the last on caudal peduncle (sometimes appearing as two groups, the first at rear base of dorsal fin); in addition, there is a group of dark spots on nape, another on pectoral base, a single spot or pair of spots at mid-base of caudal fin, and a row down the mid-side of body, most of which are not in line with the spots above; often an irregular dark bar or vertical row of spots between major groups of spots; a blackish spot anteriorly on dorsal fin; median fins dusky, the spinous portion of the dorsal with scattered small brown spots, the tips of the anal rays pale; a row of dark spots may be present along anal base.

Remarks: No differences were noted between western Atlantic specimens of this species and Günther's brief description of *Blennius aequipin-*

nis from West Africa. Victor G. Springer supplied a 35-mm kodachrome transparency of the holotype of *aequipinnis* (BMNH 1851.8.26.10) and the following data: female, 31.8 mm standard length, dorsal rays XII,13; anal rays II,16; pectoral rays 14/14; pelvic rays I,4/I,4, segmented caudal rays 13 (upper and lower two unbranched), vertebrae 32, prenasal pores 3/3; predorsal pores about 15; preopercular and some circumorbital pores paired; nasal cirri (left) 4; supraorbital cirri (free tips, left) 11; dental formula $\frac{1-24-1}{1-25-1}$. As indicated previously, the number of incisiform teeth seems to increase, in general, with size. Tooth counts were made of four specimens of western Atlantic *aequipinnis* as follows: 27 mm: 24 upper and 23 lower; 33 mm: 27 upper and lower; 37 mm: 26 upper and lower; 48 mm: 29 upper and 31 lower.

The color pattern of the body of the holotype shows very faintly on the kodachrome. A dark spot at the front of the dorsal fin could not be positively detected on the kodachrome, so A. C. Wheeler of the British Museum (Natural History) was asked to examine the type for this color marking. He reported a spot anteriorly on the fin.

Another species of *Hypleurochilus* described from West Africa, *H. bananensis* (Poll), also has I,4 pelvic rays, a deeply indented dorsal fin, and a black spot anteriorly on the dorsal fin. It differs from *aequipinnis* notably in having a low fleshy crest mid-dorsally on the postorbital part of the head, 15 dorsal soft rays, and 17 anal soft rays.

Apparently the males of *aequipinnis* are colored differently from the females. A 47-mm male collected by the writer at Isla Cubagua in the southern Caribbean was greenish gray with small orange spots in groups dorsally on the body. A female of the same size taken at the same station had dark brown spots in aggregates which were overlaid with orange dots. Both fish had orange dots on head. In preservative the groups of the spots on the body are faint on the male but conspicuous on the female.

One 26-mm specimen from Curaçao is a male with well-developed external genitalia. Another of 33 mm from Florida is just developing the fleshy knobs distally on the anal spines.

Species of *Hypleurochilus* seem to be benthic on hard substratum in shallow water. *H. aequipinnis* is consistent with this generality in its habitat. It has been collected on pilings, mangrove roots, and rock outcroppings near shore. Although it has been found in relatively clear water near a clean sand bottom, it seems to be more inclined than *bermudensis* or *springeri* to live in turbid water in association with a mud or silty sand bottom.

Erdman (1961) recorded *aequipinnis* from Puerto Rico under the name *H. bermudensis*. He used the common name "oyster blenny," in reference to the occurrence of this species on oyster-covered mangrove roots.

The stomach and intestinal contents of two specimens from Venezuela were examined. The fish had eaten cheliferan crustaceans, amphipods, unidentified crustaceans, hydroids (*Halecium*?), bryozoans (*Crisia*?), a small pelecypod, and unidentified soft animal material.

TABLE 1. Fin-ray and vertebral counts of West Indian species of *Hypleurochilus*

| Species and Locality | Dorsal Spines | | | Dorsal Rays | | | Anal Rays | | | Pectoral Rays | | | Vertebrae | | | |
|--------------------------|---------------|-----|------|-------------|----|----|-----------|----|----|---------------|----|----|-----------|----|----|----|
| | XI | XII | XIII | 12 | 13 | 14 | 14 | 15 | 16 | 13 | 14 | 15 | 30 | 31 | 32 | 33 |
| <i>bermudensis</i> | | | | | | | | | | | | | | | | |
| Bermuda | | | 5 | | 5 | | | | | 1 | 9 | | | 3 | | |
| Bahamas | | | 1 | | 1 | | | | | | 2 | | | 1 | | |
| Florida | 1 | 17 | | 3 | 15 | | 2 | 16 | | 1 | 35 | | 1 | 12 | | |
| <i>aequipinnis</i> | | | | | | | | | | | | | | | | |
| West Africa ¹ | | | 1 | | 1 | | | | | | | 1 | | 1 | | |
| West Indies | 1 | 20 | | 15 | 6 | | | 18 | 3 | 1 | 41 | | | 1 | 11 | |
| Florida | | 26 | | 10 | 16 | | 2 | 7 | 17 | 4 | 46 | 2 | | 1 | 13 | 2 |
| Yucatan | | 6 | | 3 | 3 | | | 3 | 3 | 3 | 9 | | | | | 3 |
| Venezuela | | 8 | | 3 | 5 | | | 3 | 5 | 15 | 1 | | | | | |
| <i>springeri</i> | | | | | | | | | | | | | | | | |
| West Indies | 1 | 24 | 3 | 6 | 22 | | 10 | 17 | 1 | 2 | 53 | 1 | | | | 7 |
| Florida | | 2 | | 1 | 1 | | 1 | 1 | | | 4 | | | | | |
| Los Roques (Ven.) | | 3 | | | 3 | | 1 | 2 | | 1 | 5 | | | | | |

¹ Counts from holotype by Victor G. Springer.

The only difference that was detected between the holotype (apparently the only specimen known from West Africa) and the American material was a slightly higher count of the supraorbital and nasal cirri of the type for its size. As may be seen in Figure 2, the point representing the 11 supraorbital cirri of the type lies above the average for western Atlantic specimens. The 31.8-mm holotype of *aequipinnis* has 4 cirri at the posterior edge of the anterior nostril. Only western Atlantic specimens in excess of 40 mm have 4 nasal cirri at the posterior edge of the anterior nostril (of 10 specimens 40 mm or longer, six have 4 nasal cirri, three have 3 and one has 2).

It is possible that more differences can be shown by direct comparison of West African and American fishes, but for the present, the identification of the latter as *aequipinnis* seems in order. This does not represent the only example of a blennioid fish that is common to both sides of the tropical Atlantic. *Blennius cristatus* Linnaeus, *Ophioblennius atlanticus* (Cuvier and Valenciennes) and *Labrisomus nuchipinnis* (Quoy and Gaimard) have the same distribution.

***Hypleurochilus springeri*, new species**

Fig. 1C

Holotype: USNM 257884-Fl, female, 48.2 mm standard length, Cabo Rojo, Puerto Rico, SW of lighthouse, rocky shore with sand and seagrass in 0 to 5 ft, Pro-Noxfish, J. E. Randall, 16 August 1964.

Paratypes: PUERTO RICO: UMML 1758 (33.8 mm), Bahía de Yegua, coral reef and some sand in 1–10 ft, J. E. Randall, D. S. Erdman, R. E. Maytag, 12 November 1957; UPR 2370 (20.5 mm), Punta Arenas, Mayaguez, coral reef with little sand, 1–5 ft, J. E. Randall, 3 November 1964; U.S. VIRGIN ISLANDS: LACM 7507 (29 mm), Beehive Point, Lameshur Bay, St. John, about 90% rock and coral and 10% sand in 0–18 ft, J. E. and H. A. Randall and R. E. Schroeder, 14 June 1961; BRITISH VIRGIN ISLANDS: ANSP 93077 (2: 24.5 and 27.0 mm), White Bay, Guana Island, 20–100 ft from sand beach with some boulders, 4–8 ft, D. M. and A. N. Barringer, 12–16 July 1959; NETHERLANDS ANTILLES: ST. MARTIN: UMML 6910 (42.3 mm), Little Bay, sand with occasional algal-covered rocks at shore, J. E. Randall and C. P. Idyll, 7 July 1959; ANTIGUA: UF 11408 (2: 12.6 and 17.4 mm), Windward Bay, 5–10 ft, C. R. Gilbert and B. M. Endicott, 26 April 1964; UF 11354 (26.9 mm), south side near point east of Carlisle Bay, 30 ft, C. R. Gilbert and B. M. Endicott, 26 April 1964; DOMINICA: USNM 198262 (16.5 mm), west coast north of Mero, rocks and mud, V. G. Springer, *et al.*, 1 November 1964 (courtesy of Bredin–Archbold–Smithsonian Biological Survey of Dominica); VENEZUELA: ARCHIPIÉLAGO LOS ROQUES, Dos Mosquises: MBUCV V-962 (2: 27.6 and 33.2 mm), T. Cobo and F. Weibezahn, 5 August 1963; MBUCV V-1476 (22.9 mm), T. Cobo, O. Infante, and F. Weibezahn, 25 August 1963; JAMAICA: UMML 14953 (17.8 mm), west end of Maiden Cay, shore, J.

and H. Randall, J. Chess, T. Gordon, and D. Steven, 16 December 1959; GRAND CAYMAN: UF 12275 (2: 17.2 and 17.6 mm), north end of West Bay Beach, 3–8 ft, C. R. Gilbert and J. C. Tyler, 20 October 1964; UF 12276 (2: 11.5 and 19.0 mm), south side of Georgetown, 1–7 ft, C. R. Gilbert and J. C. Tyler, 23 October 1964; UF 12277 (10.8 mm), north side of Georgetown, coral heads and “ironshore” formation, 75 yards in front of Soto’s Marina, 5–12 ft, C. R. Gilbert and J. C. Tyler, 24 October 1964; BAHAMAS: GRAND BAHAMA ISLAND: ANSP 92742 (17.0 mm), Wood Cay, R. E. Schroeder and S. Gross, 28 June 1959; HOG ISLAND: ANSP 81688 (39.5 mm), Paradise Beach, sand and rock bottom in 5–6 ft, rotenone, C. G. Chaplin, 1 March 1953; EXUMAS: UMML 15978 (3: 16.3–41.1 mm), Stocking Island, east shore, sand and rock in 2–8 ft, W. A. Starck, II and T. J. Starck, 13 July 1959; ANSP 102130 (3: 16.3–28.5 mm), same data as preceding; CAT ISLAND: UMML 5940 (2: 26.0 and 33.0 mm), 1.4 mi. N New Bight in 8 ft, W. A. Starck, II, 17 July 1959; UNITED STATES: FLORIDA: UF 10884 (2: 24.2 and 30.4 mm), Looe Key, Florida Keys, 4.5 mi. SSW U. S. Highway 1, C. R. Gilbert and R. Parles, 1–2 November 1963; PUERTO RICO: UPR 1481 (26.6 mm), same collecting data as holotype.

Diagnosis: Pelvic rays 14; dorsal soft rays 12 or 13 (usually 13); anal soft rays 14 to 16 (usually 15, rarely 16); vertebrae 32; dorsal fin deeply indented; length of pectoral fin 3.1 to 3.7 in standard length; supraorbital cirri 2 to 11 in size range 20 to 48 mm standard length; color of adults similar to *aequipinnis*, but with 5 groups of dark spots along the back instead of 6 (first 3 in the same position on both species), no blackish spot anteriorly on dorsal fin (on some specimens there is a faint smudge) and no dark spot at mid-base of caudal fin. Instead of groups of spots, the last 3 markings of juveniles consist of solid blackish bars which extend below the mid-line (the first 2 markings anteriorly on the body are faint).

Description: Depth of body 3.5 to 4.3 in standard length, the greatest depth occurring at approximately the pectoral base; width of body 5.5 to 6.5 in standard length; least depth of caudal peduncle 10.5 to 11.5 in standard length; length of caudal peduncle measured from base of last dorsal ray 8.3 to 10 in standard length (if measured from point of juncture of last anal membrane to body, the length is contained about 15 times in standard length); head length 3 to 3.4 in standard length; head steep, the profile above upper lip forming an angle of about 60 degrees with the horizontal; eye about 3 to 4.1 in head length, the greatest diameter diagonally from lower anterior to upper posterior edge; snout short, the horizontal length 4.3 to 5.5 in head length; maxillary extending to or nearly to a vertical at center of eye; interorbital space concave and narrow, the least bony width 8.7 to 11 in head length.

Gill opening ending at about level of lower edge of pectoral base, its length contained about 1.7 times in head length; a fleshy fold linking lower end of gill opening across isthmus to opening on other side; upper lip broad, its greatest depth about 1.5 to 1.6 in head length; a secondary

fold on side of upper lip (not extending across median part of snout); a ventrally directed flap on side of lower lip (distance equivalent to space occupied by 15 lower teeth contained in gap between medial edges of labial flaps of holotype); holotype with 32 upper and 32 lower incisiform teeth (fewer on smaller specimens—see Table 2), incisiform teeth firmly set in jaws, elongate, and close-set with lips slightly pointed and slightly incurved; each side of upper jaw with a curved canine tooth posterior to and separated by a gap from incisiform series; each side of lower jaw with a large curved canine lying posterior but adjacent to the last incisiform tooth; supraorbital tentacle a transverse flap with a fringe of 2 to 11 cirri (fewer on smaller specimens); posterior nostril near rim of orbit at level of upper edge of pupil; anterior nostril with a fleshy rim and an elongate flap on rear edge containing 2 to 6 cirri; no other tentacle or cirri present.

Lateral line nearly straight anteriorly, curving downward near end of pectoral fin and continuing a short distance midlaterally (to level of base of seventh soft ray of anal fin of holotype); anterior portion of lateral line with pores at ends of short vertical branches above and below main canal; curved and straight posterior portions of lateral line consisting of disjointed segments. Suborbital canal between region behind center of eye and nostrils with about 10 ventrally-directed rami containing one or more pores; small region immediately in front of anterior nostril with 3 pores (a few additional very small pores are also visible on some specimens); vertebrae 32 (including hypural); branchiostegal rays 6.

Dorsal rays XII (rarely XI or XIII), 12 or 13 (usually 13); dorsal fin origin slightly anterior to upper end of gill opening; first dorsal spine 7.5 to 10 in standard length; dorsal fin deeply indented posteriorly in spinous portion, the last dorsal spine 15 to 22 in standard length, 2.5 to 3.4 in length of first dorsal soft ray; longest (fourth or fifth) dorsal spine 6.5 to 8.2 in standard length (ninth dorsal spine of holotype abnormally short); longest (fourth to sixth) dorsal soft ray 5.3 to 5.9 in standard length. Anal rays II, 14 to 16 (usually 15, rarely 16); origin of anal fin in line with base of tenth dorsal spine; anal spines of presumed mature males tipped with fleshy rugose knobs; first anal spine of females nearly embedded in postanal tissue; first anal soft ray 8.7 to 11 in standard length; longest (twelfth or thirteenth) anal soft ray 6.8 to 7.8 in standard length; membrane connecting last anal ray to caudal peduncle posterior to comparable membrane of dorsal fin; dorsal and anal soft rays unbranched. Caudal fin rounded, its length 4.7 to 5.3 in standard length; segmented caudal rays 13, the upper and lower two unbranched, the central 11 branched. Pectoral rays nearly always 14; pectoral fins relatively long, reaching a vertical at about base of third anal soft ray; interradial membranes of pectoral fins from ray tip to ray tip on about the upper 10 rays; lower 4 membranes incised along the uppermost of each adjacent pair of rays. Pelvic rays I, 4, the spine a short splint, the last two rays very slender; pelvic fins inserted at ventral branchial tissue fold, anterior to origin of dorsal fin; length of pelvic fins 4.2 to 4.7 in standard length.

TABLE 2. Measurements and counts of the holotype and selected paratypes of *Hypleurochilus springeri* (in thousandths of the standard length)

| | HOLOTYPE | | PARATYPES | | | |
|---|---|-----------------------------------|-------------------------------|------------------------------|-----------------------------|-----------------------------------|
| | USNM 257884-F1 Puerto Rico Female | UMML 6910 St. Martin Female | UMML 15978 Bahamas Male | UMML 5490 Bahamas Male | UF 10884 Florida Male | UPR 2363 Puerto Rico Female |
| Standard length (mm) | 48.2 | 42.3 | 41.1 | 33.0 | 30.3 | 26.6 |
| Greatest body depth | 262 | 286 | 243 | 239 | 257 | 233 |
| Greatest body width | 180 | 175 | 173 | 181 | 165 | 154 |
| Head length | 301 | 328 | 297 | 303 | 329 | 289 |
| Snout length | 67 | 69 | 66 | 66 | 60 | 64 |
| Eye diameter | 81 | 83 | 73 | 75 | 99 | 98 |
| Postorbital length of head | 160 | 165 | 167 | 151 | 164 | 139 |
| Suborbital depth ¹ | 39 | 42 | 46 | 44 | 43 | 34 |
| Body interorbital space | 31 | 33 | 34 | 33 | 30 | 30 |
| Least depth of caudal peduncle | 91 | 94 | 88 | 91 | 92 | 87 |
| Caudal peduncle length ² | 102 | 101 | 100 | 112 | 108 | 120 |
| Snout to origin of dorsal fin | 274 | 290 | 292 | 297 | 297 | 274 |
| Snout to origin of anal fin | 560 | 554 | 518 | 530 | 512 | 557 |
| Snout to origin of pelvic fin | 218 | 229 | 224 | 230 | 208 | 218 |
| Dorsal fin base length ³ | 664 | 673 | 662 | 655 | 665 | 640 |
| Anal fin base length ³ | 370 | 364 | 389 | 385 | 397 | 353 |
| Pectoral fin length | 324 | 284 | 304 | 278 | 291 | 293 |
| Pelvic fin length | 220 | 224 | 210 | 221 | 237 | 233 |
| 1st dorsal spine length | 102 | 106 | 114 | 118 | 132 | 111 |
| Longest dorsal spine length | 122 | 130 | 143 | 145 | 154 | 150 |
| Last dorsal spine length | 50 | 45 | 49 | 54 | 66 | 60 |

(Table 2 continued)

| | HOLOTYPE USNM 257884-F1 Puerto Rico Female | UMML 6910 St. Martin Female | UMML 15978 Bahamas Male | PARATYPES UMML 5490 Bahamas Male | UF 10884 Florida Male | UPR 2363 Puerto Rico Female |
|---------------------------|---|-----------------------------------|-------------------------------|---|-----------------------------|-----------------------------------|
| 1st dorsal ray length | 153 | 151 | 153 | 148 | 165 | 152 |
| Longest dorsal ray length | 187 | 172 | 173 | 170 | 189 | 169 |
| 2nd anal spine length | 41 | 47 | 56 | 63 | 92 | 56 |
| 1st anal ray length | 91 | 94 | 109 | 91 | 115 | 94 |
| Longest anal ray length | 147 | 142 | 129 | 130 | 140 | 131 |
| Caudal fin length | 203 | 189 | 204 | 197 | 214 | 207 |
| Longest suborbital cirrus | 33 | 40 | 78 | 79 | 92 | 37 |
| Lower canine tooth length | 25 | 24 | 32 | 27 | 33 | 26 |
| Dorsal rays | XII,13 | XII,13 | XII,12 | XIII,12 | XII,13 | XII,12 |
| Anal rays | II,15 | II,14 | II,15 | II,15 | II,15 | II,14 |
| Pectoral rays | 14(14) | 14(14) | 14(15) | 14(14) | 14(14) | 14(14) |
| Pelvic rays | I,4 | I,4 | I,4 | I,4 | I,4 | I,4 |
| Lateral-line pores | 27 | 23 | 24 | 23 | 19 | 21 |
| Gill rakers | 11 | 11 | 13 | 12 | | |
| Upper incisiform teeth | 32 | 30 | 27 | 22 | 24 | 24 |
| Lower incisiform teeth | 32 | 30 | 26 | 21 | 25 | 23 |
| Supraorbital cirri | 9(11) | 9(8) | 8(7) | 3(3) | 5(5) | 5(3) |
| Nasal cirri | 6(6) | 4(4) | 2(2) | 4(4) | 2(4) | 2(2) |

¹ Minimum distance between eye and groove above upper lip.² Horizontal distance from last dorsal ray base to end of hypural plate.³ Distance between bases of first spine and last ray. In the case of the anal fin of females, the measurement is between base of second anal spine and last anal ray.

Color of holotype in life greenish gray with 5 groups of squarish dark brown blotches along back, each composed of 4 composite blotches, one forming each corner of the square; first group of blotches centered at base of third dorsal spine, second on eighth spine, third on second ray, fourth on eighth ray, and the last on caudal peduncle; a series of smaller dark blotches along mid-lateral line, some of which line up with larger blotches above; head and about anterior half of body densely spotted with orange dots; an indistinct dark blotch on pectoral base; ventral part of head and abdomen pale gray; behind and slightly below eye a whitish line encircling a roundish area about as large as eye which is slightly darker than rest of head; median fins pale with orangish brown spots that tend to form diagonal rows in dorsal fin and irregular vertical rows in caudal fin; indistinct dark brown spots along base of anal fin; tips of anal rays pale; pectoral membranes hyaline, the rays spotted with brownish yellow; pelvic fins pale; iris with 8 spoke-like bars of orange-red, the upper part a little bluish. In alcohol the specimen is tan, the dark brown markings of the body and spots in median fins remaining, but there is no trace of the orange dots and only vestiges of the brownish yellow spots on the pectoral rays; 2 faint dark bars run ventrally from eye, one vertically behind corner of mouth and an anterior one which runs slightly diagonally across side of upper lip; a slight concentration of dark pigment on the first interdorsal membrane, but not enough to regard as a spot.

A 12.6-mm juvenile from Antigua displays 3 prominent blackish bars posteriorly, the most posterior traversing caudal peduncle; broad bar beneath soft portion of dorsal fin dividing below mid-lateral line into two sections that reach anal base; most anterior of the 3 dark bars beginning at base of indented portion of dorsal fin and nearly reaching midventral line; 2 more anterior bars on the body are only faintly discernible. On progressively larger juveniles the 3 posterior bars do not reach as far ventrally and tend to break up into spots, but they remain much darker than the 2 anterior groups of blotches until large adult size is attained.

Victor G. Springer (personal communication) reported the life color of a 16.5-mm specimen from Dominica as follows: first broken bars on body coral pink mixed with melanophores, remaining 3 solid bars predominantly black with some light coral pink dorsally (progressively less pink on posterior bars); spaces between bars pale with faint irregular yellow suffusions; venter pale; pectoral base coral red mixed with melanophores and some light yellow; snout and interorbital with brilliant coral red markings; dorsal spines, and to a lesser degree, dorsal rays with faint coral pink spots and melanin; caudal fin with 3 very faint coral pink bands, the base very faintly yellow; anal rays suffused with faint pink and melanin; upper pectoral rays transparent, middle ones light pink and lower rays coral pink; base of rays with dark points surrounded by light yellow; pelvic fins faint coral pink; iris brilliant coral red.

Remarks: Judging from existing collections, *Hyppleurochilus springeri*

is the smallest of the West Indian species of the genus. The largest example is the holotype, 48.2 mm standard length ($2\frac{1}{4}$ inches total length). The species is not common; on only one occasion have more than two specimens been taken at a single large rotenone station. All but one of the specimens have been collected in less than 10 ft of water. The usual habitat is rock along a sandy shore in clear, relatively calm water.

The stomach contents of two paratypes from Puerto Rico were examined. The fish had eaten polychaetes, the thoracic appendages of a barnacle, amphipods and other crustaceans, soft animal material and a small amount of filamentous algae.

The species is known from the Florida Keys and many localities throughout the West Indies. It is named in honor of Victor G. Springer in recognition of his research and continued interest in blennioid fishes.

I propose the common name "orange-spotted" blenny for this species. Although *H. aequipinnis* also has orange spots, they are not as evident as on *springeri*.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NEW *STENODYNERUS* FROM NORTH AMERICA
(HYMENOPTERA; EUMENIDAE)

BY R. M. BOHART

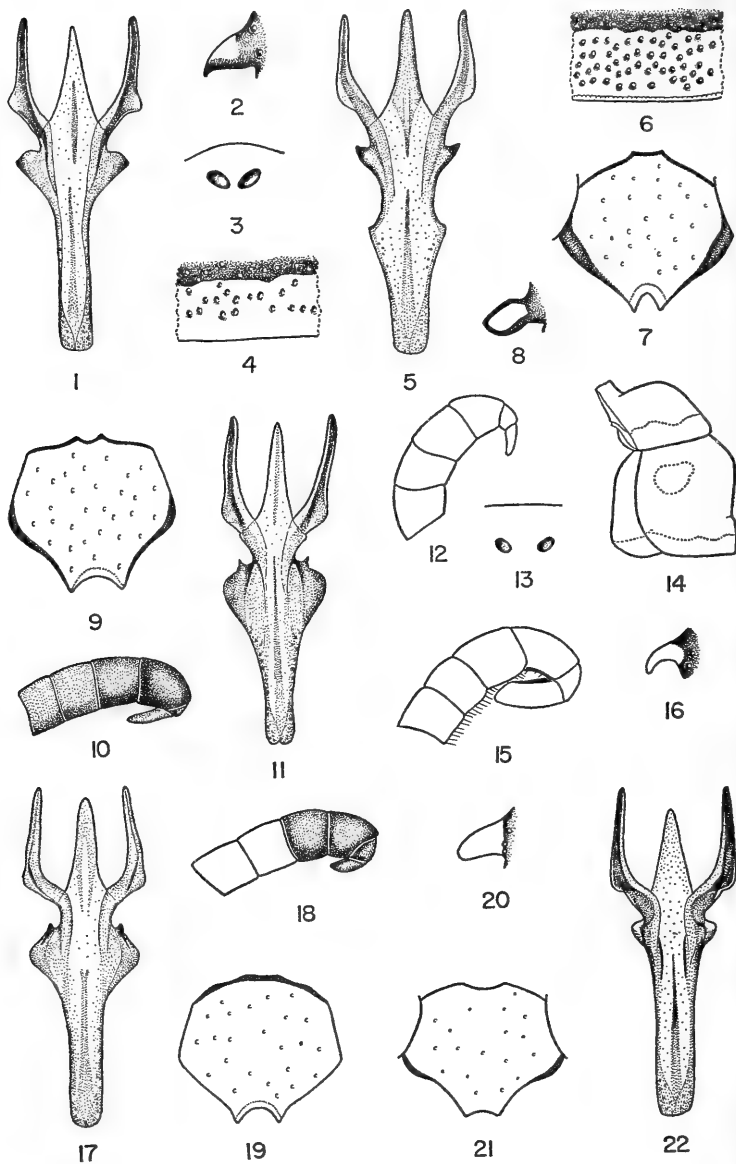
University of California, Davis

Several infrequently seen new species of *Stenodynerus* have accumulated during many years of study on North American Eumenidae. Biological studies now under way provide an additional impetus for naming the new forms at this time. Type material will be deposited in the following cooperating institutions as indicated in the distribution records: American Museum of Natural History (AMNH); California Academy of Sciences (CAS); Cornell University (Cornell U.); Los Angeles County Museum (LACM); Harvard Museum of Comparative Zoology (MCZ); Nevada State Department of Agriculture (NSDA); Oregon State University (OSU); University of Arizona (U. Ariz.); University of California at Berkeley (CIS), at Davis (UCD), at Riverside (UCR); University of Colorado (U. Colo.); University of Kansas (KU); U. S. National Museum (USNM); Utah State University (USU); Washington State University (WSU).

Illustrations were made by Mrs. Ellen Parker based on camera lucida sketches. Aedeagus figures are from flattened mounts.

***Stenodynerus canus canus* Bohart**, new species and subspecies

Male holotype: Length 8 mm. Black, marked with whitish as follows: clypeus, mandible mostly, scape in front, lower orbit, frontal spot, postocular dot, two anterior spots on pronotum, tegula, spot beneath, parategula, postscutellar band, posterior margins of tergites I-VI and sternites II-III, free spots on tergites I-II, leg extensively including tarsi toward base. Antennal hook brownish, wings lightly brown-stained. Pubescence minute, inconspicuous. Punctuation moderate to fine, clypeus with small and slightly striatiform punctures, those on summit of tergite I fine, near apex of II well separated (Fig. 4). Shape of clypeus, prehumeral pits and parategula as in Figs. 2, 3, 9; flagellum shape about



as in *coniodes*, described below (Fig. 18), but gradually redder within toward apex; no interocellar tubercles; no propodeal shelf behind post-scutellum; mid femur not depressed basoventrally; tergite II thickened at apex about 0.5 ocellus diameter; sternite II with a basomedian crease; profile of tergite II low and smoothly curved; genitalia as in Fig. 1.

Female: Length about 9.5 mm. Scape often all dark; clypeus with two spots at top, a crescent or all dark; postscutellar band often broken; legs sometimes mostly dark; sternite III dark, tergites III-VI sometimes all dark; tarsi dark. Clypeus unusually long; vertex pit fairly large, shallow and punctate.

Holotype: Male (UCD), Bear Pass Creek, Butte Co., Idaho, 21 July 1947 (R. M. Bohart).

Paratypes: 19 males, 41 females, May to August, IDAHO: Harpster Grade, Idaho Co. (W. F. Barr, U. Idaho); Moscow Mt. (UCD); Webb (W. F. Barr, U. Idaho); Murphy Hot Springs, Owyhee Co. (T. O'Connell, U. Idaho); WASHINGTON: Ewan (R. C. Shannon, USNM); Wawawai (L. Turner, WSU); Asotin (V. Argo, USNM); near Ellensburg (E. I. Schlinger, UCR); BRITISH COLUMBIA: near Armstrong (J. Wynne, UCD); OREGON: Rufus (R. M. Bohart, UCD); Lick Creek Ranger Station, Wallowa National Forest (Bolinger-Jewett, OSU, UCD, CAS); Austin (H. A. Scullen, OSU); Steens Mts. (Bolinger-Jewett, OSU); NEVADA: near Carlin (R. H. Beamer *et al.*, KU); UTAH: Logan (R. M. and G. E. Bohart, UCD); Mill Creek Canyon, Salt Lake Co. (J. L. Eastin, USU); Echo (J. L. Eastin, UCD); Wellsville Mts. (R. M. Bohart, UCD); Ogden (AMNH); Webb (W. F. Barr, U. Idaho); WYOMING: Yellowstone National Park (A. and H. Dietrich, Cornell U.); Lander (G. E. Bohart, UCD); MONTANA: Beaver Creek (S. J. Hunter, AMNH); COLORADO: Florissant (S. A. Rohwer, USNM, CAS, UCD); Cripple Creek (S. A. Rohwer, USNM); near Cedaridge (R. Bauer, UCD); Electra Lake (AMNH); Aspen (Cornell U., AMNH); near Boulder (U. N. Lanham, U. Colo.; G. Alexander, UCD).

Systematics: There is apparently a relationship to *lucidus* Rohwer which has similar male genitalia and general structure. In *lucidus*, however, the punctuation is much finer and the ocular emargination is

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FIGS. 1-4, *S. canus*; 1, aedeagus; 2, parategula; 3, prehumeral pits; 4, punctuation near apex of tergite II. FIGS. 5-8, *S. hybogaster*; 5, aedeagus; 6, punctuation near apex of tergite II; 7, male clypeus; 8, parategula. FIG. 9, *S. canus*, male clypeus. FIGS. 10-11, *S. opalinus*; 10, terminal flagellomeres of male; 11, aedeagus. FIGS. 12-14, *S. hybogaster*; 12, terminal flagellomeres of male; 13, prehumeral pits; 14, profile of abdominal segments I and II. FIGS. 15-16, *S. innobilis*; 15, terminal flagellomeres of male; 16, parategula. FIGS. 17-20, *S. coniodes*; 17, aedeagus; 18, terminal flagellomeres of male; 19, male clypeus; 20, parategula. FIGS. 21-22, *S. innobilis*; 21, male clypeus; 22, aedeagus.

dark in both sexes. *S. canus* is superficially like *kennicottianus* Saussure, which differs in having large punctures at the summit of tergite I. The markings of *canus* specimens from the Pacific Northwest are much more reduced, especially in the female, than those from Colorado and Nevada.

***Stenodynerus canus helvolus* Bohart, new subspecies**

Male holotype: Length 8 mm. Markings sulfur yellow, arranged as described for typical *canus* except: two scutellar spots, lateral propodeal spot, spots of tergite I attached, free spots on sternite II, bands on sternites IV-V.

Female: Length about 9.5 mm. Clypeus usually all yellow except for a narrow peripheral black rim but sometimes with a median black mark, scutum usually dotted, tergites III to V and sternites IV-V usually banded, free spots sometimes on sternite II.

Holotype: Male (UCD), Boca, Nevada Co., California, 19 June 1962 (R. M. Bohart).

Paratypes: 25 males, 16 females, June and July all from CALIFORNIA: Boca (R. M. Bohart *et al.*, UCD, USNM, CIS, UCR, KU, AMNH, LACM); Truckee (E. P. VanDuzee, CAS, UCD); Gold Lake, Sierra Co. (C. L. Fox, CAS); Sagehen Creek, Nevada Co. (M. E. Irwin, UCD). I have seen Californian specimens also from Quincy, Plumas Co.; Bridge Creek Camp, Norvell, Susan River Camp, Summit Camp, Lassen Co.; Hat Creek and Old Station, Shasta Co.; Hebron Summit, Siskiyou Co.; Cedar Pass and Davis Creek, Modoc Co.; and White Mts., 10,000 feet, Mono Co. Out-of-State localities are 16 mi. NW Flagstaff, Arizona; Reno, Nevada; and Klamath Lake, Oregon.

Systematics: In addition to the yellow color, *helvolus* has the markings generally more extensive than in typical *canus*. In *helvolus* there is a parallel similarity to *kennicottianus antheus* Cameron, with which it may be collected. Here, also, the fine punctation across the summit of tergite I in *helvolus* is distinguishing.

***Stenodynerus hybogaster* Bohart, new species**

Male holotype: Length 8.5 mm. Black and yellow with red and yellow legs. Yellow are: clypeus except for narrow black margin, scape in front, lower orbit, frontal spot, narrow postocular spot, two barely separated pronotal triangles, tegula partly, spot beneath, parategula, postscutellum mostly, legs partly, distal margins of tergites I to V and sternite II, free spot on tergite II. Red are: inner side of flagellum including tip, tegula partly, legs mostly, including tarsi and hind femur entirely. Forewing brown-stained. Pubescence minute, pale, inconspicuous. Punctation moderate, fine on clypeus, coarse toward summit of tergite I with some punctures as large as ocelli, moderate but close before apex of II (Fig. 6). Shape of clypeus, tip of antenna, prehumeral pits and parategula as in Figs. 7, 8, 12, 13; ocellar area with a pair of narrow and smooth tubercles,

not bridged above front ocellus; humeral corners somewhat upturned; propodeum rough above with indistinct pit-like punctures along lateral angle, hind face with small to large shallow punctures arranged semicircularly, no shelf behind postscutellum; tergite I short and broad; tergite II with a hump at basal one-third, a transverse crease at distal one-third in profile, distal reflex less than 1.0 ocellus diameter (Fig. 14); sternite II with a basomedian crease; basal extension of paramere with sharp basal projection; aedeagus with pointed submedian expansion which is broader than the sharp median expansion (Fig. 5).

Female: Length about 10 mm. Clypeus with a yellow mark across top, orbit with a dot only, propodeal angles yellow. Vertex pit somewhat larger than an ocellus, delimited in front by coarse punctures.

Holotype: Male (MCZ), Riley Co., Kansas, 25 September on *Polygonum* (J. B. Norton).

Paratypes: 4 males, 11 females, April to August, MISSISSIPPI: Oxford (MCZ); MISSOURI: St. Louis (P. Rau, USNM); KANSAS: Gove Co. (F. X. Williams, UCD); Pottawatomie Co. (H. E. Evans *et al.*, MCZ); NEBRASKA: Rulo (UCD); Child's Point (UCD); TEXAS: Davis Mts. (R. H. Beamer, KU); COLORADO: Crowley Co. (UCD); NEW MEXICO: Las Cruces and Mesilla (T. D. Cockerell, USNM, CAS, UCD).

Systematics: This species is related to *kennicottianus* Saussure which has the summit of tergite I rough, also. The humped second tergite and broad parategulae distinguish *hybogaster* from related species, however (Figs. 8, 14).

Stenodynerus innobilis Bohart, new species

Male holotype: Length 7.5 mm. Black with whitish yellow as follows: mandible basally, clypeus, Y-shaped spot above, scape in front, lower orbit broadly, rhomboid humeral spots, tegula, spot beneath, parategula, scutal dot, postscutellar band; legs mostly; distal bands on tergites I–VI, broadly interrupted on III, attached spots on I, free pair on II; distal bands on sternites II–III; antenna light reddish within on flagellomeres I–VIII; wings lightly stained. Pubescence moderate, fulvous on frons where it attains 3 ocellus diameters, silvery elsewhere and not conspicuous except on ventral surface of flagellum (Fig. 15), especially on V to VIII. Punctuation weak on clypeus which is mostly polished, moderate elsewhere, a trifle larger at summit of tergite I than subapically, well separated subapically on II (about as in *canus*, Fig. 4). Shape of clypeus, tip of antenna, parategula as in Figs. 15, 16, 21; prehumeral pits about as in *hybogaster*, Fig. 13; interocellar area a raised platform which overhangs each ocellus; humeral carina a little raised; propodeum shelfless behind postscutellum; mid femur a little depressed basoventrally; tergite II evenly convex in profile, sternite II with a basomedian crease; genitalia as in Fig. 22.

Female: Length about 8.5 mm. Clypeus with a pale inverted U above, two small subapical spots, sometimes joined; tegula partly orange;

propodeum whitish yellow laterally; flagellum narrowly reddish within, not setose.

Holotype: Male (UCD), Hellhole Canyon, Borrego Valley, San Diego Co., California, 25 March 1959 (A. A. Grigarick).

Paratypes: 4 males, 14 females, March to June and October, all from California: San Diego Co.: Borego (R. M. Bohart, UCD), Culp Canyon (E. I. Schlinger *et al.*, UCR, UCD, CAS, USNM), Sentenac Canyon (UCD); Imperial Co.: 6 mi. W Coyote Wells (R. R. Snelling, LACM); Riverside Co.: Deep Canyon (M. E. Irwin, E. I. Schlinger, UCR, UCD), Tahquitz Canyon (F. Parker, L. Stange, UCD); Andreas Canyon (J. C. Hall, UCD); Palms to Pines Highway (C. D. Michener, KU), Palm Springs Station (J. W. MacSwain, CIS).

Systematics: A Great Basin species, *superpendentis* Bohart, is closely related and shares with *innobilis* the overhanging interocellar tubercles, the incurved parategula, and the setose male flagellum. *S. innobilis* differs by its yellowish white rather than white markings, by the absence of a preapical channel across tergite II, and by the large but not hatchet-shaped flagellar hook in the male (Fig. 15).

STENODYNERUS PULVIVESTIS GROUP

Of the four species in the *pulvivistis* group only *pulvivistis* Bohart is customarily without orange-red markings on the first tergite. The characters shared by all four species are as follows: length about 7 mm in male and 9 mm in female; ivory are: mandible basally, clypeus entirely in male and basal inverted U in female, scapal stripe in male, V-shaped spot on lower frons, inner orbital spot, postocular spot, large anterior pronotal spots which are narrowly separated medially, scutal dot, parategula, tegula partly, spot beneath, postscutellum mostly, fore and mid femora distally, all tibiae externally, stripe on fore basitarsus in male, all basitarsi dark in female, apical band on tergite I narrowed sublaterally, apical bands on tergites II, IV–VI, sternite II, free spot on tergite II. Pubescence minute, silvery, bloom-like. Punctuation moderate to somewhat coarse, moderately fine across summit of tergite I, well separated toward apex of II (as in *canus*, Fig. 4). Clypeal tip narrow, semicircularly incised in male (Fig. 19), weakly incurved in female, interocellar area not tuberculate; prehumeral pits of pronotum small and close together (as in *canus*, Fig. 3); parategula ovoid, straight along inner margin (Fig. 20); mid femur not depressed basoventrally; posterior face of propodeum somewhat concave, partly shiny; tergite II with apical margin as thick as one-half ocellus diameter; sternite II evenly convex in profile, creased basomedially; submedian expansion of aedeagus with sharp, anteriorly directed teeth; vertex depression of female shallow and small, posteriorly limited by a fine, nearly right-angled carina.

The only previously described species in the group is *pulvivistis* Bohart (1949: 249, Fig. 6). Three new species are described here, *chisosensis*, *coniodes* and *opalinus*.

***Stenodynerus chisosensis* Bohart, new species**

Male holotype: Flagellum very dark, a little lighter within; orange-red are: tegular spot, propodeum, femora, tibiae partly, tarsi, basal abdominal segment mostly. Pubescence of sternites IV to VI fine, appressed, inconspicuous. Flagellar hook strongly dorsoventrally flattened in profile; propodeum without an obvious shelf behind postscutellum; aedeagus about as in Fig. 17; median expansion with minute, basomarginal, thorn-like teeth.

Female: About as in male but clypeus usually with non-ivory part reddish.

Holotype: Male (USNM), Chisos Mts., Brewster Co., Texas, 10 June 1908 (Mitchell and Cushman).

Paratypes: 5 males, 5 females, May to September, TEXAS: Chisos Mts. (Mitchell and Cushman, USNM, UCD); Devils River, Val Verde Co. (Bishopp and Pratt, USNM); Salt Flat, Hudspeth Co. (H. E. Evans, MCZ); Quemado (P. M. Marsh, UCD); Anhalt, Comal Co. (Cornell U.); Fort Davis (L. A. Stange, UCD).

Systematics: The combination of shelfless propodeum, flat antennal hook, unusually dark antenna, all-red hind basitarsus in the male, extensively red propodeum and tergite I in both sexes, and minute aedeagal teeth are diagnostic.

***Stenodynerus conoides* Bohart, new species**

Male holotype: Flagellum dark externally, reddish yellow within except for VIII to XI which are brown (Fig. 18); orange red are: coxae, trochanters, femora mostly, tibiae within, propodeum, abdominal segment I mostly; mid and hind basitarsi dark brown. Pubescence of sternites IV to VI thick, conspicuous, semi-erect. Flagellar hook (XI) moderately stout in profile (Fig. 18); clypeus and parategula as in Figs. 19, 20; propodeum without an obvious shelf behind postscutellum; genitalia as in Fig. 17, median expansion of aedeagus with a sharp marginal angle on either side.

Female: With red markings as in male but often extensively red on clypeus, prothorax and abdominal segments II and following; antenna extensively red within.

Holotype: Male (UCD), Panamint Springs, Inyo Co., California, 15 July 1953 (E. I. Schlinger).

Paratypes: 37 males, 28 females, May to September, CALIFORNIA: Panamint Springs (E. I. Schlinger, UCD, UCR, CAS, USNM); 3 mi. S Olancha (P. D. Hurd, CIS); Batchelder Springs, Inyo Co. (H. K. Court, UCD, KU, ANSP, AMNH, UCR); near Big Pine (A. D. Telford, P. M. Marsh, UCD); near Death Valley Junction, Inyo Co. (N. L. Rump, AMNH); Walker Lake (A. T. McClay, UCD); Kramer Junction, San Bernardino Co. (M. E. Irwin, UCD); Whitewater, Riverside Co. (J. W. MacSwain, CIS); Borrego Valley, San Diego Co. (B. J. Adelson and P. D. Hurd, CIS; F. X. Williams, CAS); NEVADA: near Nixon (F.

D. Parker, *et al.*, NSDA, Cornell U., UCD, CAS, USNM); Jean (G. E. Bohart, UCD); 6 mi. E Currant, Nye Co. (G. I. Stage, CIS); 20 mi. S Winnemucca (T. R. Haig, UCD); Pyramid Lake (A. S. Menke, UCD); Mt. Montgomery (R. M. Bohart, UCD); IDAHO: 10 mi. NE Kuna (W. F. Barr, U. Idaho); UTAH: Bellevue (UCD); Trout Creek (H. B. Stafford, USNM). Metatypes, 4 males, 5 females, NEW MEXICO: Bernalillo, Carrizozo, Las Cruces; TEXAS: Sierra Blanca, El Paso, Marathon, Fort Stockton.

Systematics: This extensively red-marked species shares with *chisosensis* the red legs and the dark mid and hind basitarsi in the male. Other features which distinguish it when used in concert are the red propodeum in both sexes, the light red inner surface of the female antennae and the bicolored condition in the male, the rather stout flagellar hook in the male, the shelfless propodeum, the unusually pubescent male sternites, and the distinctive aedeagus (Fig. 17), which is angled rather than toothed.

***Stenodynerus opalinus* Bohart, new species**

Male holotype: Flagellum dark externally, light red within but becoming gradually darker on VIII-X, hook (XI) yellowish orange; abdominal segment I orange red except for apical border; mid and hind basitarsi broadly ivory externally. Pubescence of sternites IV to VI fine, appressed, inconspicuous. Flagellar hook (XI) strongly flattened dorso-ventrally in profile (Fig. 10); propodeum without an obvious shelf behind postscutellum; genitalia as in Fig. 11, median expansion of aedeagus with minute, marginal, thorn-like teeth.

Female: About as in male but propodeum red and basitarsi dark brown; flagellum extensively light red within; clypeus black except for basal ivory spot.

Holotype: Male (UCD), Lone Pine Creek, Inyo Co., California, 6 June 1939, on *Eriogonum fasciculatum* (R. M. Bohart).

Paratypes: 35 males, 29 females, April to September, CALIFORNIA: near Lone Pine (R. M. Bohart, UCD, CAS, USNM); Batchelder Springs, Inyo Co. (H. K. Court, UCD); 6 mi. W Essex (R. H. Beamer *et al.*, KU, UCD); Windmill Station, San Bernardino Co. (H. E. Cott, UCD); 12 mi. SE Ivanpah (H. J. Adelson, CIS); Morongo Valley, Riverside Co. (P. H. Timberlake, UCR); Palm Springs (E. P. Van Dyke, CAS; R. H. Beamer *et al.*, KU, UCD); Palm Springs Station (J. W. MacSwain, CIS, UCD); Palm Desert (P. D. Hurd, CIS, CAS; W. F. Barr, U. Idaho); Desert Springs (J. C. Hall, UCD); Deep Canyon, Riverside Co. (E. I. Schlinger, UCR); Cathedral City (P. H. Timberlake, UCR); Soledad, Los Angeles Co. (E. I. Schlinger, UCD); Borego (F. X. Williams, UCR; P. D. Hurd, CIS); Fish Springs, Imperial Co. (E. P. VanDuzee, CAS); NEVADA: Crystal (G. E. Bohart, UCD); Nixon (F. D. Parker, R. M. Bohart, UCD, NSDA); ARIZONA: Maricopa Mts. (H. and M. Townes, UCD); Palm Canyon (G. Butler, D. Tuttle, U. Ariz.); Wellton (A. J.

Basinger, UCR); Organ Pipe National Monument (G. Butler, F. Werner, U. Ariz.); Tucson (G. Butler, U. Ariz.; V. Vesterby, UCD); 25 mi. E Mesa (H. A. Scullen, OSU); NEW MEXICO: Las Cruces (L. D. Beamer, KU).

Systematics: Distinguishing features taken in combination are the non-red femora and tibiae, the ivory striped mid and hind basitarsi in the male, the shelfless propodeum, the light red inner surface of the antenna which in the male ends in a somewhat yellowish and flattened hook, the dark propodeum in the male, and the minutely toothed aedeagus.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DESCRIPTIONS OF NEW BATS (*CHOERONISCUS*
AND *RHINOPHYLLA*) FROM COLOMBIA

BY CHARLES O. HANDLEY, JR.

U. S. National Museum, Washington, D. C.

An imperfectly known endemic mammalian fauna is found on the Pacific coast and Andean foothills of northwestern Ecuador and Colombia and northward into Panama, where it crosses to the Caribbean slope and continues into Costa Rica and Nicaragua and in some instances even into Mexico. The relatives of its endemic species are mostly South American, but some are Mexican. Species characteristic of this fauna, such as *Carollia castanea*, *Vampyressa nymphaea*, *Heteromys australis*, *Oryzomys bombycinus*, and *Hoplomys gymnurus*, were among the mammals collected in the course of virological studies of the Rockefeller Foundation on the Pacific coast of Colombia in 1962 and 1963. In addition there were striking new species of *Choeroniscus* and *Rhinophylla*.

I am grateful to Wilmot A. Thornton, Center for Zoonoses Research, University of Illinois, Urbana (formerly at Universidad del Valle, Cali, Colombia) for the opportunity to study the Colombian material here reported. Richard G. Van Gelder, American Museum of Natural History (AMNH); Philip Hershkovitz and J. C. Moore, Chicago Natural History Museum (CNHM); Bernardo Villa-R, Instituto de Biología, Mexico (IB); Barbara Lawrence, Museum of Comparative Zoology, Harvard University (MCZ); J. Knox Jones, Jr., Museum of Natural History, University of Kansas (KU); William H. Burt, Museum of Zoology, University of Michigan (UMMZ); A. Musso, Sociedad de Ciencias Naturales La Salle (LS); and Juhani Ojasti, Universidad Central de Venezuela (UCV) kindly permitted me to study comparative material. Specimens in the U. S. National Museum are designated by the abbreviation (USNM). Studies which led to the following descriptions were supported in part by National Science Foundation Grant G-19415.

All measurements are in millimeters. For definition of cranial measurements see Handley (1959: 98-99). Capitalized color terms are from Ridgway (1912).

CHOERONISCUS

There are few specimens of the poorly known glossophagine genus *Choeroniscus* in collections. The limits of variation in the genus are incompletely known (Sanborn, 1954), and until now its separation from *Choeronycteris* has been questionable. A specimen of a new species of *Choeroniscus* from the west coast of Colombia greatly extends knowledge of the genus and strengthens its stature as a genus distinct from *Choeronycteris*.

***Choeroniscus periosus*, new species**

Holotype: USNM no. 344918, adult female, alcoholic and skull, collected 1 February 1963, by Wilmot A. Thornton, at the Río Raposo, near sea level, 27 km south of Buenaventura, Departamento de Valle, Colombia, original number 592.

Etymology: Greek *periosus*, immense.

Distribution: Known only from the type-locality.

Description: Body size large (forearm 41.2; greatest length of skull 30.3). Dorsal mass effect coloration (after three month's submersion in formalin) rich blackish-brown; basal three-fourths orange-brown in dorsal hairs; underparts but slightly paler than dorsum. Vibrissae abundant and conspicuous on snout and chin. Ears, chin, noseleaf, lips, membranes, legs, feet, and fingers blackish. Lancet of noseleaf relatively narrow, with three notches on each side near tip, and with prominent vertical median ridge on anterior face. Membranous "tongue-channel" on chin unusually well developed, protruding 1.5 mm forward and 2.0 mm up from lower lip; dorsal and anterior edges scalloped. Ear short, tip rounded, antitragus well defined; tragus spatulate, 3.8 mm long, with margins entire (except for prominent posterior notch opposite anterior base), and with anterior edge and posterior basal lobe thickened. Inter-femoral membrane broad, naked. Hind legs naked. Calcar shorter than foot, not lobed.

Rostrum longer than braincase; cranium little elevated from basicranial plane; profiles of rostrum and cranium evenly tapered, without sharp angle in between; no orbital ridges or processes; zygoma absent; lambdoidal crest low; sagittal crest absent; maxillary toothrows subparallel; palate relatively broad anteriorly and narrow posteriorly; posterolateral margin of palate not notched; postpalatal extension parallel-sided, tubular, reaching posterior to level of mandibular fossae; mesopterygoid fossa reduced to a straight-sided, V-shaped notch; hamular processes greatly inflated and approaching, but not quite touching, auditory bullae; basal pits prominent, separated by broad median ridge.

Dentition weak. Dental formula $\frac{2}{0}, \frac{1}{1}, \frac{2}{3}, \frac{3}{3} = 30$. Upper incisors small, unicuspid; inner upper incisors (I^1) separated by a space three to four times the width of the teeth; larger, outer upper incisor (I^2) separated by somewhat less than its own width from I^1 and from canine.

Upper canine with small posterobasal cusp. Upper premolars very narrow; median cusp, particularly of anterior premolar, very little higher than well-defined anterior and posterior cusps. Upper molars with cusps greatly reduced; M^1 and M^2 similar in size and shape, M^3 slightly shorter and broader. Upper premolars widely spaced; molars closer together, but not touching. Lower premolars narrow, with well-defined, subequal anterior, posterior, and median cusps. Metaconid cusps of lower molars enlarged and protoconid cusps reduced; paraconid cusps in line with protoconids, not inflected. Anterior lower premolar close behind, but not touching, canine; spaces between premolars great, but spaces between P_4 and M_1 and between other molars, much less.

Measurements (All external dimensions taken from specimen in alcohol): Total length 62, tail vertebrae 10, hind foot 12, ear from notch 15, forearm 41.2, tibia 13.3, calcar 7.9.

Greatest length of skull 30.3, zygomatic breadth 11.0, postorbital breadth 4.7, braincase breadth 9.9, braincase depth 7.4, maxillary tooth row length 10.8, postpalatal length 7.0, palatal breadth at M^3 5.2, palatal breadth at canines 4.6.

Comparisons: *C. periosus* can be distinguished from all other species of *Choeroniscus* by its longer (longer than braincase), more robust rostrum; more inflated hamular process; and larger size (e.g., forearm 41.2 vs. 32.4–36.9; greatest length of skull 30.3 vs. 19.3–24.4; maxillary tooth row 10.8 vs. 6.5–9.2). It is allied with the Amazonian species *C. minor*, *C. intermedius*, and *C. inca*, and distinguished from the Central American and northern South American *C. godmani*, in having the posterolateral margin of the palate unnotched and the cranium not so markedly elevated from the basicranial plane.

Remarks: With the addition of *C. periosus*, the genus *Choeroniscus* includes five nominal species. *C. periosus* is much the largest species; *C. inca* Thomas, *C. intermedius* Allen and Chapman, and *C. minor* Peters are intermediate in size; and *C. godmani* Thomas is smallest.

Choeroniscus is the most specialized of a group of nominal glossophagine genera which may be characterized briefly as follows:

| | | |
|----------------------------------|---------------------------------|-----------------------|
| Teeth nearly normal | pterygoids normal | <i>Lichonycteris</i> |
| Teeth slightly reduced | pterygoids? | <i>Scleronycteris</i> |
| Teeth reduced; PM high | pterygoids slightly specialized | <i>Hylonycteris</i> |
| Teeth reduced; PM high | pterygoids specialized | <i>Choeronycteris</i> |
| Teeth greatly reduced; PM low | pterygoids greatly specialized | <i>Choeroniscus</i> |

Lichonycteris has 26 teeth and the other genera have 30.

As here understood, the genus *Choeronycteris* includes *Musonycteris harrisoni* Schaldach and McLaughlin, which is distinguished from *Choeronycteris mexicana* Tschudi principally by its strikingly elongated rostrum and associated modifications in proportions. The disparity in

rostral proportions is much greater, however, between *Choeroniscus godmani* and *Choeroniscus periosus* than between *Choeronycteris mexicana* and *Choeronycteris harrisoni*. Thus, to distinguish *C. harrisoni* as representative of a separate genus tends to obscure relationships in this segment of the Glossophaginae. *Musonycteris* should be regarded as a synonym of *Choeronycteris*.

Specimens examined: *Choeroniscus godmani*. COLOMBIA: META: Restrepo, 1 (MCZ). COSTA RICA: Vicinity of San José, 3000 ft, 5 (AMNH). HONDURAS: Cantoral, 1 (AMNH); La Flor Archaga, 2 (AMNH). MEXICO: CHIAPAS: Pijijiapan, 50 m, 1 (UMMZ); GUERRERO: 1 mi. SE San Andrés de la Cruz, 700 m, 1 (UMMZ); OAXACA: 16 km ENE Piedra Blanca, 1 (IB); SINALOA: San Ignacio, 700 ft, 1 (KU). NICARAGUA: El Realejo, 1 (KU), 2 (USNM). VENEZUELA: BOLIVAR: 38 km S El Dorado, 1 (UCV); DISTRITO FEDERAL: Caracas (Santa Monica), 900 m, 1 (LS); Chichiriviche, 1 (UCV). *Choeroniscus inca*. BRITISH GUIANA: Kamakusa, 1 (AMNH); Kartabo, 1 (AMNH). ECUADOR: Los Pozos, 2 (AMNH). VENEZUELA: BOLIVAR: Chimantá-tepuí, 1300 ft, 9 (CNHM). *Choeroniscus intermedius*: TRINIDAD: Irois Forest, 1 (AMNH); Maracas, 1 (AMNH), Princetown, 1 (holotype of *C. intermedius*, AMNH); Sangre Grande, 1 (AMNH). *Choeroniscus minor*. BRAZIL: PARÁ: Belém, 3 (USNM). PERU: PASCO, San Juan, 900 ft, 1 (USNM); Puerto Melendez, above Marañon, 1 (AMNH). *Choeroniscus periosus*. COLOMBIA: VALLE: Río Raposo, 1 (holotype of *C. periosus*, USNM). Also, numerous specimens of *Lichonycteris*, *Hylonycteris*, and *Choeronycteris* (including *C. harrisoni*).

RHINOPHYLLA

The carollinine genus *Rhinophylla* has until now been known only from the basin of the Rio Amazonas and the lowlands of northeastern South America (Husson, 1962: 152-153). The sole representative of the genus, *R. pumilio* Peters, has been regarded as closely related to, but more specialized than, the species of the abundant and widespread genus *Carollia* (Miller, 1907: 147). It is thus rather surprising to find in the collection of W. A. Thornton from the west coast of Colombia a number of specimens of a striking new species of *Rhinophylla* that is even more strongly differentiated from *Carollia* than is *R. pumilio*.

Rhinophylla alethina, new species

Holotype: USNM no. 324988, adult male, skin and skull, collected 13 July 1962, by Wilmot A. Thornton, at the Río Raposo, near sea level, 27 km south of Buenaventura, Departamento de Valle, Colombia, original number 172.

Etymology: Greek, *alethinos*, genuine.

Distribution: Known only from the type-locality.

Description: Size large for genus (forearm 34.9-37.2 mm). Coloration blackish, darkest anteriorly, paler posteriorly. In holotype, head and nape black, shading to Fuscous-Black on rump; underparts varying

from black on chin to Fuscous-Black on chest and to Natal Brown on abdomen. Another specimen (Univ. del Valle 220) slightly paler: Fuscous-Black anteriorly and Natal Brown posteriorly on dorsum, and correspondingly paler on underparts. Hairs of dorsum and abdomen sharply tricolor: at mid-dorsum Slate-Black basally, with broad Benzo Brown median band; on sides, neck, and shoulders median band pales almost to Ecru-Drab and shows through to surface rather prominently. Noseleaf, lips, ears, tragus, fingers, forearms, legs, feet, and all membranes blackish. Fur soft, woolly; legs, feet, interfemoral membranes, and basal two-thirds of forearm hairy; interfemoral membrane fringed. Interfemoral membrane narrow (about 5 mm at base); calcar short (less than length of metatarsals); tibia and forearm stout; pinna with anterior margin convex, posterior margin concave, tip blunt, antitragus triangular; tragus usually blunt, with upper posterior margin entire or notched; lancet of noseleaf longer than broad, upper margins slightly concave; horseshoe of noseleaf with median half of base bound to lip; chin ornament composed of four parts—a central triangular element (apex down), a pair of narrow, elongated lateral elements converging ventrally but not meeting (their outer margin more or less scalloped), and a small, circular median ventral element.

Skull like that of *Rhinophylla pumilio* but rostrum slightly heavier (broader and deeper anteriorly), and a distinct low sagittal crest present.

Dentition, with the exception of inner incisors, extremely weak and reduced; formula $\frac{2}{2} - \frac{1}{1} - \frac{2}{2} - \frac{3}{3} = 32$. Inner upper incisor (I^1) large, adz-shaped, with cutting edge entire; outer upper incisor (I^2) small, featureless. Canine simple, without cingulum or subsidiary cusps. Anterior upper premolar (P^1) small and featureless; posterior upper premolar (P^4) almost rectangular, longer than broad, with large median cusp and tiny posterior cusp. M^1 short and M^2 shorter, almost triangular in occlusal shape, each with a single prominent internal cusp (the metacone); protocone obliterated; paracone barely indicated in M^1 , obliterated in M^2 ; parastyle and metastyle, particularly the latter, low and weakly developed; M^3 reduced to a tiny featureless spicule.

Inner lower incisors (I_1) large, trilobed (occasionally bilobed); I_2 small, unicuspid. Canine simple, without accessory cusps. Premolars simple, unicuspid; anterior premolar wider than any succeeding tooth. Molars very narrow, tricuspid; anterior and posterior cusps low on M_1 and M_2 and more or less obliterated on M_3 .

Measurements (Extremes in parentheses, preceded by means and followed by number of individuals (only adults included)). Measurements of the total length, ear, and weight were made by the collector in the field. All other measurements were made by me in the laboratory.): Total length ♂ 55, 58; hind foot ♀ 11 (11–11) 4, ♂ 11 (10–11) 6; ear from notch ♂ 15, 16; forearm ♀ 36.4 (35.5–37.2) 4, ♂ 35.7 (34.9–36.6) 4; tibia ♀ 12.3 (11.2–12.9) 4, ♂ 12.0 (11.5–12.5) 4; calcar ♀ 3.1 (3.0–3.5) 4, ♂ 3.4 (3.3–3.5) 5. Weight ♂ 12 gm, 16 gm.

Cranial measurements of male holotype: Greatest length of skull 19.5, zygomatic breadth 10.7+; postorbital breadth 5.3, braincase breadth 8.9, braincase depth 7.5, maxillary tooth row length 4.9, postpalatal length 7.2, palatal breadth at M^2 6.4, palatal breadth at canines 5.1.

Comparisons: Specimens of *R. alethina* are slightly larger than specimens of *R. pumilio* from the valley of the Rio Amazonas; have the inter-femoral membrane narrower; calcar shorter; hind legs stouter; legs, feet, and interfemoral membrane (including posterior margin) more hairy; fur more woolly in texture; and coloration, including that of lips, ears, and membranes, darker, more blackish. As noted in the description, the skulls of the two species are very similar. However, except for the inner incisors, the teeth of *R. alethina* are smaller and weaker, and the tooth rows are shorter than in *R. pumilio*. *R. alethina* has cutting edges of I^1 and I_2 entire rather than notched; P^4 shorter; cusps of upper molars more reduced; and I_2 , P^1 , M^3 , and lower molars notably smaller.

Aside from its relative *R. pumilio*, *R. alethina* is likely to be confused only with the Glossophaginae and with *Carollia castanea*. Its non-extensible tongue and lack of rostral elongation are sufficient to distinguish it from the Glossophaginae. From *Carollia castanea* it can be distinguished easily by its blacker coloration, narrow, fringed interfemoral membrane, hairy legs, simple chin ornament, and smaller, simplified teeth. In most of these characteristics *R. alethina* differs more from the species of *Carollia* than *R. pumilio* does.

Specimens examined: *Rhinophylla alethina*. COLOMBIA: VALLE Rio Raposo, 11 (including the holotype, USNM), 1 (Univ. del Valle). *Rhinophylla pumilio*. BRAZIL: PARÁ: Belém, 52 (USNM). ECUADOR: Boca de Río Curaray, 2 (USNM). PERU: PASCO: San Juan, 900 ft, 4 (USNM).

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

VALKANOVIA, A NEW NAME FOR THE
THECAMOEBIAN *EUGLYPHELLA* VALKANOV, 1962
NON WARTHIN, 1934 (PROTOZOA: RHIZOPODEA)

BY HELEN TAPPAN

University of California, Los Angeles

The protozoan genus *Euglyphella* and its type species, *E. delicatula* Valkanov, were described from Bulgaria by Valkanov, 1962, Doklady Bolgarskoï Akademii Nauk, v. 15, no. 2, p. 207, text-figs. 1-3, as belonging to the family Euglyphidae.

As the generic name was preoccupied by the ostracode *Euglyphella* Warthin, 1934 (Contr. Mus. Pal. Univ. Michigan, v. 4, p. 220), the protozoan is here renamed.

Valkanovia new name, is here proposed for *Euglyphella* Valkanov, 1962, type species *Valkanovia delicatula* (Valkanov) = *Euglyphella delicatula* Valkanov, 1962. The new generic name is dedicated to Prof. A. Valkanov, in recognition of his numerous important contributions to the knowledge of the testaceous Rhizopodea.



PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF *DENTIGRYPUS* WILSON
(COPEPODA, CALIGOIDA) FROM MADAGASCAR

BY ROGER CRESSEY

Smithsonian Institution, Washington, D.C.

A new species of *Dentigrypus* parasitic on the body surface of the jack, *Caranx hippos* (Linn.) was collected by the author at Nosy Bé, Madagascar during the International Indian Ocean Expedition.

I would like to acknowledge the National Science Foundation-U.S. Program in Biology for supporting the field portion of this work.

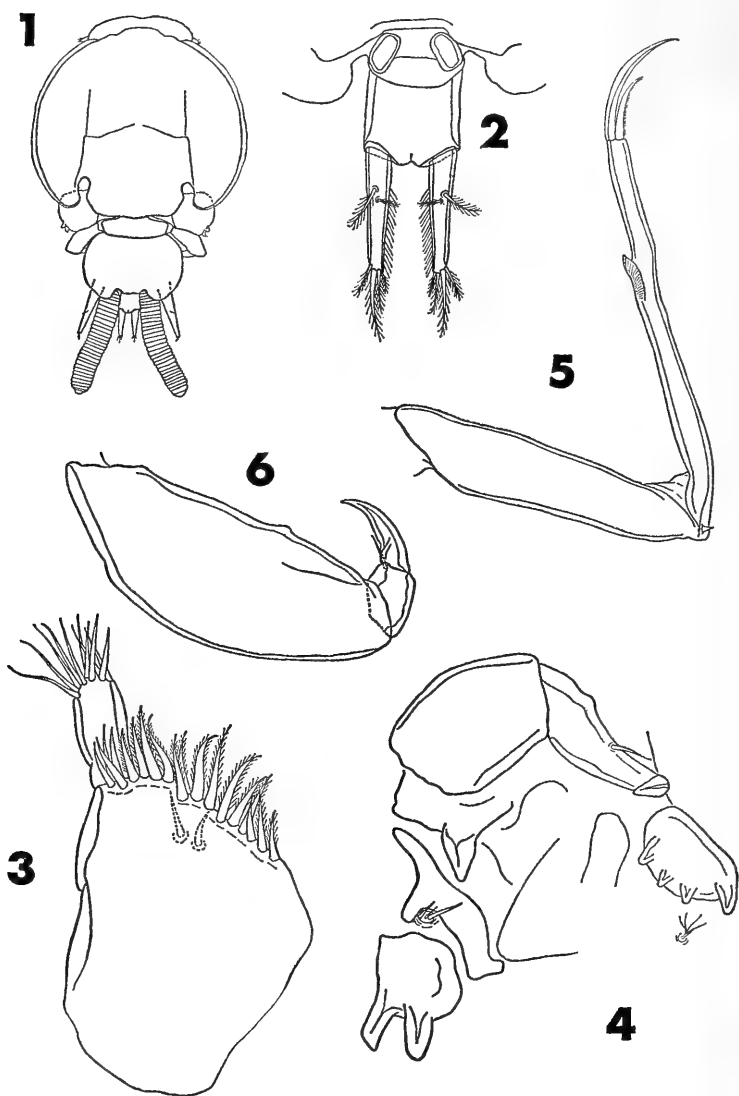
***Dentigrypus longicauda*, new species**

Specimens studied: 6 females collected from the body surface of a single specimen of *Caranx hippos* caught off Nosy Bé, Madagascar (Pointe Lokobe), 8 March 1964. Holotype ♀ (USNM 113048) and 4 paratype ♀♀ (USNM 113049) in alcohol deposited in the United States National Museum. One specimen dissected for study and retained in author's personal collection.

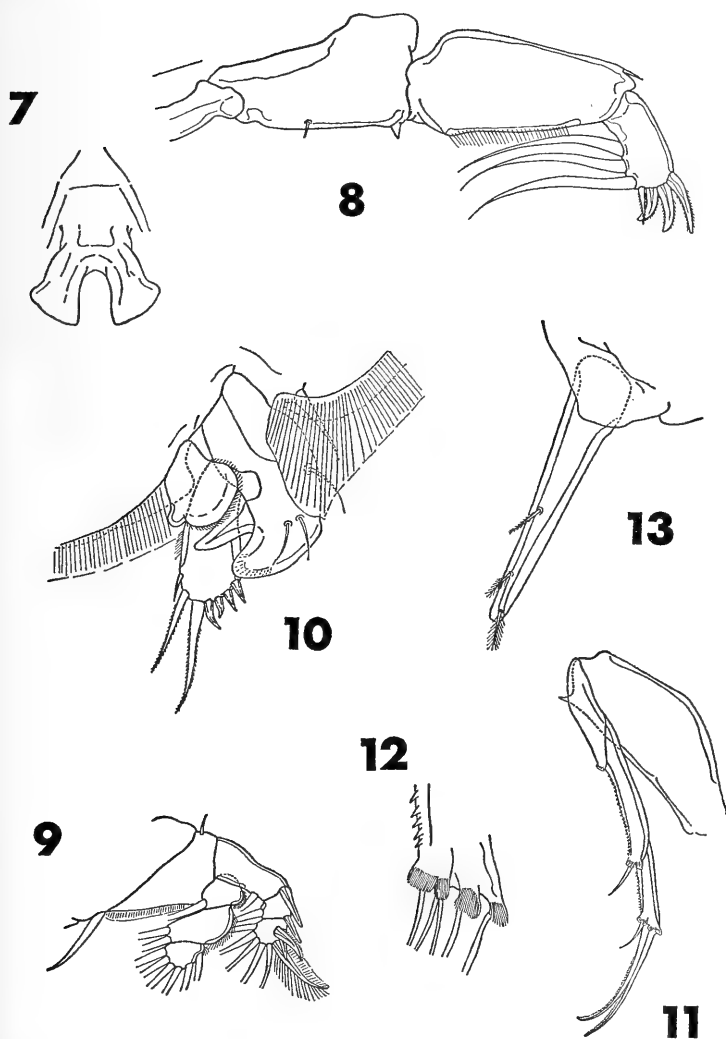
Etymology: *longicauda*—alluding to the length of the caudal rami.

Female holotype: Body form as in Fig. 1. Total length 5.6 mm (not including setae on caudal rami). Greatest width (measured at widest part of cephalon) 3.5 mm. Edge of cephalon with membrane as in Fig. 1. Cephalon nearly round. Thoracic segment 4 free. Genital segment wider than long (1.7×1.2 mm), greatest width in anterior third. Posterior corners broadly rounded and projecting. Area for spermatophore attachment near junction of genital segment and abdomen (see Fig. 2). Abdomen 1-segmented, slightly longer than wide ($420 \mu \times 360 \mu$). Caudal rami (see Fig. 2) about 4 times as long as wide (456μ long). Each ramus with 4 terminal plumose setae, 2 plumose ventral setae located near middle. Oral area of the typical caligid type.

First antenna (Fig. 3) 2-segmented. First segment bearing several plumose setae on distal border. Last segment with group of 11 naked setae at tip. Second antenna (Fig. 4) 3-segmented. Penultimate segment in form of sclerotized claw. Sclerotized cuticular process directed posteriorly near base of second antenna. Post-antennal process with prominent lateral process and 3 smaller sclerotized processes along



FIGS. 1-6. *Dentigryps longicauda* n. sp., female: 1, female, dorsal; 2, abdomen and caudal rami; 3, first antenna; 4, area of second antenna and first maxilla; 5, second maxilla; 6, maxilliped.



FIGS. 7-13. *Dentigryps longicauda* n. sp., female: 7, sternal furca; 8, leg 1; 9, leg 2; 10, leg 3; 11, leg 4; 12, distal end of last segment of leg 4; 13, leg 5.

posterior border (see Fig. 4). Mandible and mouth tube as in other species of genus. Mandible with 12 teeth at tip. First maxilla reduced to group of 3 setae anterior to postoral process (see Fig. 4). Postoral process with 2 broad sclerotized processes directed posteriorly as shown in

Fig. 4. Second maxilla (Fig. 5) 2-segmented, bearing 2 bladelike setae at tip. Longest seta with double base fusing to form single tip. Maxilliped (Fig. 6) 2-segmented, terminating in claw. Sternal furca (Fig. 7) spatulate.

Leg 1 (Fig. 8) biramose. Exopod 2-segmented, first segment with small spine on outer distal corner and inner margin with row of hairs. Terminal segment with 3 terminal spines, 1 terminal short seta, and 3 long plumose setae along inner margin. Endopod reduced to small process near base of exopod. Leg 2 (Fig. 9) biramose. Each ramus 3-segmented, armed as in figure. Leg 3 (Fig. 10) biramose. Exopod 2-segmented, first segment modified to form clawlike process bearing stout inwardly directed, spine. Last segment with 4 terminal spines and 3 terminal setae. Endopod 1-segmented, unarmed. Leg 4 (Fig. 11) uniramose. Exopod 3-segmented, each segment bearing distal spatulate processes (see Fig. 12). Last segment with 3 setae at tip, 2 longer setae fringed along outer border. Outer border of last 2 segments bearing row of spinules. Leg 5 (Fig. 13) 1.1 mm long (measured along outer border) consisting of a long, heavily sclerotized process bearing 3 short setae as shown in figure. Leg 6 absent.

Egg strings uniseriate and of usual caligoid type, about 2 mm long.

Male: Unknown.

Remarks: Lewis (1964) recognized four species in the genus *Dentigryps*. This new species differs from those four by the nature of the caudal rami, leg 3, and postantennal process. The diagnosis of the genus as given by Lewis states that the caudal rami are flattened, not filiform but his concept should be modified to include *D. longicauda*. The endopods of leg 3 in the four previously described species are 2-segmented and armed with a number of setae, whereas the endopod of leg 3 in *D. longicauda* is reduced to one unarmed segment.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

HETERAPHRODITA ALTONI, A NEW GENUS AND
SPECIES OF POLYCHAETE WORM (POLYCHAETA,
APHRODITIDAE) FROM DEEP WATER OFF OREGON,
AND A REVISION OF THE APHRODITID GENERA

BY MARIAN H. PETTIBONE

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Among some polychaetes collected off the mouth of the Columbia River, Oregon, by Mr. Miles S. Alton, were 11 specimens of a species of Aphroditidae collected at a single deep-water station in 900 fathoms. The aphroditid is herein described as a new species belonging to a new genus.

I have taken this opportunity to review the genera in the family. Two genera, *Pontogenia* Claparède and *Laetmonice* Kinberg, have been emended and several others have been put into synonymy. In the diagnosis of the Aphroditidae and key to the genera, as herein revised, I have included neither *Triceratia* Haswell, based on the indeterminable and perhaps incomplete *T. araeoceras* Haswell, 1883, from Australia nor *Hermionopsis* Seidler, based on the doubtful *H. levisetosa* Seidler, 1923, from Kerguelen.

This study was aided in part by a grant from the National Science Foundation (NSF GB-1269).

FAMILY APHRODITIDAE

Diagnosis: Body relatively large, short and broad, ovate, oblong, or spindle-shaped; flattened ventrally, arched dorsally; consisting of few segments (less than 60). Ventral surface of body and parapodia covered with minute spherical or conical papillae. Prostomium suboval, with single median antenna, comprised of ceratophore and terminal filament, and pair of long palps. Usually with a well-developed papillated facial tubercle ventral to median antenna and anterior to mouth. Peristomium consisting of first few segments around mouth. First or tentacular segment projecting laterally and ventrally to prostomium, with 2 pairs of tentacular cirri; uniramous setigerous lobes with numerous capillary setae.

Parapodia biramous, supported by internal acicula; with large overlapping dorsal scales or elytra attached by strong muscular attachments to elytophores, usually 15 pairs (up to 20), located on segments 2, 4, 5, 7, on alternate segments to 25, then on every third segment; long dorsal cirri on segments lacking scales. All but one pair of parapodia with short ventral cirri; longer on second segment, lateral to mouth. Neuropodia conical, with few, stout, dark, simple neurosetae arranged in 3 tiers (may be more numerous and of different type in few anterior and posterior segments). Notopodia wide and low, with simple notosetae of several kinds, including capillary setae which may extend dorsally forming a dorsal feltage, more or less developed. Pharynx strong, muscular, eversible, with several rows of numerous soft papillae around opening, without chitinous jaws. Pygidium very small, without anal cirri. Adapted to burrowing in mud or creeping on soft bottom.

KEY TO THE GENERA OF APHRODITIDAE

- 1A. Elytra covered by compact dorsal feltage (must be removed to see elytra) 2
- 1B. Elytra not covered by compact dorsal feltage (fine capillary setae may form slightly developed dorsal feltage). Papillated facial tubercle well developed 3
- 2A. With some stout, dark, amber-colored protective notosetae extending laterally or dorsolaterally. Prostomium without ocular peduncles. Papillated facial tubercle well developed. Neurosetae of few anterior segments numerous, bipinnate *Aphrodita* Linné
- 2B. Without stout protective notosetae. Prostomium with short rounded ocular peduncles. Facial tubercle not developed. Neurosetae of few anterior segments few in number, with basal spur and variable number of extra teeth; not bipinnate *Heteraphrodita*, new genus
- 3A. Notosetae including some dark, amber-colored protective setae with tips in form of barbed arrow (harpoon setae). Some anterior neurosetae bipinnate *Laetmonice* Kinberg
- 3B. Notosetae curved over dorsum; without harpoon setae 4
- 4A. Notosetae flattened, serrated. Prostomium with paired clublike ocular peduncles. Anterior neurosetae with some extra teeth (not bipinnate) *Pontogenia* Claparède
- 4B. Notosetae sabrelike, smooth. Prostomium without ocular peduncles. Anterior neurosetae bipinnate *Aphrogenia* Kinberg

Genus *Aphrodita* Linné, 1758

Halithea Savigny, in Lamarck, 1818. Type-species (herein designated): *Aphrodita aculeata* Linné, 1758.

Milnesia Quatrefages, 1865. Type-species (herein designated): *M. nuda* Quatrefages, 1865; = young form of *A. aculeata* Linné (according to Fauvel, 1923, p. 34).

Aphroditella Roule, 1898. Type-species (monotypy): *A. pallida* Roule, 1898; = young form of *A. aculeata* Linné (according to Fauvel, 1923, p. 34); = distinct species (according to Bellan, 1964, p. 19).

Type-species (designated by Malmgren, 1867, p. 3): *A. aculeata* Linné, 1758. Gender: feminine.

Diagnosis: Aphroditids with dorsal feltage well developed, concealing elytra completely. Elytra 15 pairs, smooth. Prostomium without ocular peduncles. Facial tubercle well developed, papillated. Notosetae all smooth, of 3 kinds: capillary setae forming matted dorsal feltage; dark, acicular, protective spines projecting dorsolaterally; iridescent capillary setae projecting laterally. Neurosetae dark, stout, smooth or with lateral spur, with slightly curved tips, with or without hood which may be frayed or pilose. Neurosetae of anterior few segments bipinnate.

Genus *Laetmonice* Kinberg, 1855; emended

Hermione Blainville, 1828. Type-species (monotypy): *Halithea hystrix* Savigny, in Lamarck, 1818. Not description and figure in Blainville; = questionably *Pontogenia chrysocoma* (Baird) (according to Claparède, 1868, p. 357). Preoccupied by Meigen, 1800, in Diptera; *fide* Neave, 1939, p. 625.

Letmonicella Roule, 1898. Type-species (monotypy): *L. spinosissima* Roule, 1898; = young of *L. filicornis* Kinberg (according to Fauvel, 1923, p. 36).

Halogenia Horst, 1915. Type-species (designated by Hartman, 1959, p. 55): *H. arenifera* Horst, 1915.

Hermonia Hartman, 1959. New name for *Hermione* Blainville, preoccupied.

Type-species (monotypy): *L. filicornis* Kinberg, 1855. Gender: feminine.

Diagnosis: Aphroditids with dorsal feltage poorly developed, not completely covering elytra. Elytra up to 20 pairs, smooth. Prostomium with short ocular peduncles. Facial tubercle well developed, papillated. Notosetae of 3 kinds: acicular, smooth or granular, arched over dorsum; stout, long, dark-amber colored, with tips in form of barbed arrow (harpoon setae); short to long capillary setae, sometimes forming a poorly-developed dorsal feltage. Neurosetae dark, stout, with slightly curved tips, with lateral spur, some with accessory denticles under rostrum or with unilateral fringe of long stiff filaments. Some bipinnate neurosetae on a few anterior segments.

Remarks: *Hermione* Blainville, as indicated in the synonymy above, is preoccupied. The name is further confused, as was pointed out by Claparède (1868, p. 357), by the fact that the species described under the name *Hermione hystrix* by Blainville was not the same as *Halithea hystrix* Savigny. Claparède suggested that the description and figures of Blainville should questionably be referred to *Pontogenia chrysocoma* (Baird) and that the confused name of *Hermione* Blainville be abandoned and replaced by that of *Laetmonice* Kinberg, since they seemed to be

generically synonymous. Unfortunately, this suggestion has not been followed, and *Hermione* has continued to be used until it was replaced by *Hermonia* Hartman (1959, p. 56), a new name for *Hermione* Blainville, preoccupied. However, this does not take into account the confused state of the type specimen of Blainville.

Laetmonice (or *Laetmatonice*, a secondary spelling by Kinberg that has been widely used) and *Hermione* have been separated mainly on the basis of the neurosetae: toothed but without a fringe of hairs in *Hermione*; toothed and with a fringe of hairs in *Laetmonice*. I agree with Claparède that the differences should be considered to be of specific but not of generic importance. *Halogenia* Horst falls in place under the emended *Laetmonice* Kinberg.

Genus *Aphrogenia* Kinberg, 1855

Type-species (monotypy): *A. alba* Kinberg, 1855. Gender: feminine.

Diagnosis: Aphroditids without dorsal feltage covering elytra. Elytra 13 pairs, with scattered papillae. Prostomium with eyes sessile, without ocular peduncles. Notosetae all smooth, of 2 kinds: stout, smooth, sabrelike, curved over dorsum; fine, capillary. Neurosetae dark, stout, with basal spur. Neurosetae of anterior few segments with extra teeth, some bipinnate.

Genus *Pontogenia* Claparède, 1868; emended

Pontogenessa Monro, 1924. *Type-species* (monotypy and original designation): *P. obscura* Monro, 1924.

Type-species (monotypy): *Hermione chrysocoma* Baird, 1865. Gender: feminine.

Diagnosis: *Aphroditids* with dorsal feltage poorly developed, not concealing elytra completely. Elytra up to 18 pairs, smooth. Prostomium with clublike ocular peduncles. Facial tubercle well developed, papillated. Notosetae of 3 kinds: long, capillary setae; large, golden yellow, flattened paleal setae arched over dorsum, serrated or toothed along curved margin; short, capillary setae. Neurosetae dark, stout, with slightly curved tips, smooth or with lateral spur. Neurosetae of anterior few segments smooth or with extra teeth, not bipinnate.

Remarks: According to the generic definition by Monro, *Pontogenessa* was distinguished from *Pontogenia* by the neurosetae which are simple, lacking the lateral spur characteristic of *Pontogenia*. The distinction is herein considered to be of specific rather than generic importance.

Heteraphrodita, new genus

Type-species: *H. altoni*, new species. Gender: feminine.

Diagnosis: *Aphroditids* with dorsal feltage well developed, concealing elytra completely. Elytra 13 pairs, smooth. Prostomium with short rounded ocular peduncles. Facial tubercle absent. Notosetae of 2 kinds: long, capillary, forming matted dorsal feltage; short, capillary;

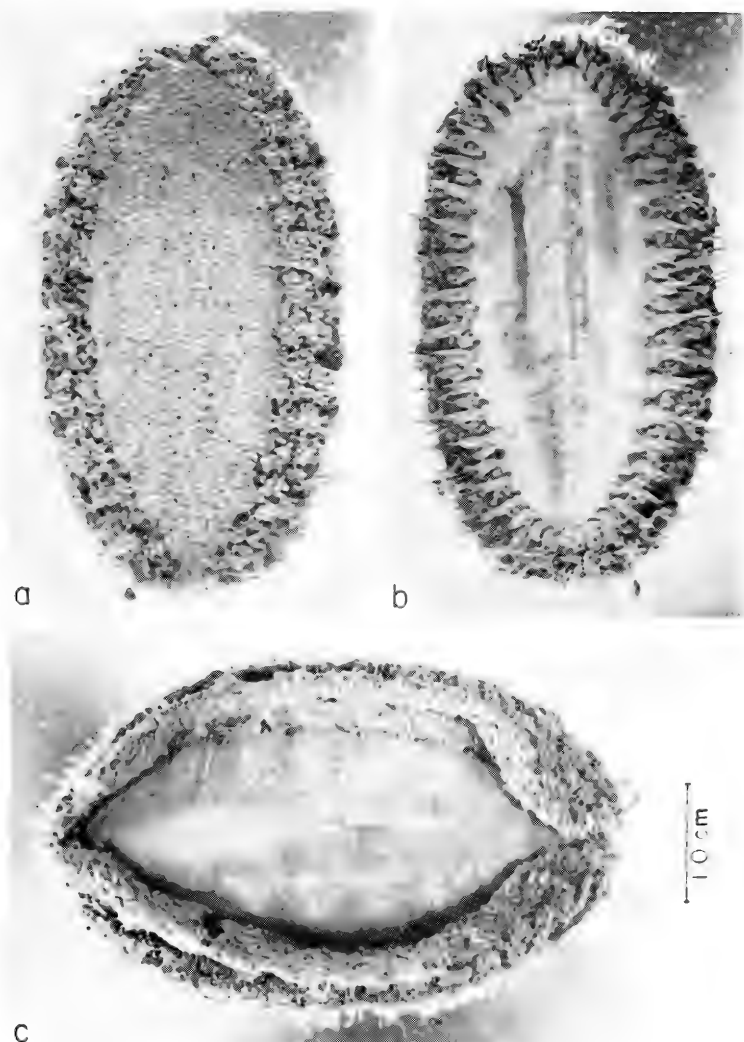


FIG. 1. *Heteraphrodita altoni*, new species. a, dorsal view; b, ventral view; c, dorsal view, with dorsal feltage cut back exposing the elytra.

without stout protective notosetae. Neurosetae with 1 or 2 basal spurs, hooked tips, and subdistal spinous sheaths along one side, in some setae digitiform spinous processes extending beyond distal tips. Neurosetae of anterior few segments similar to those following, not bipinnate.

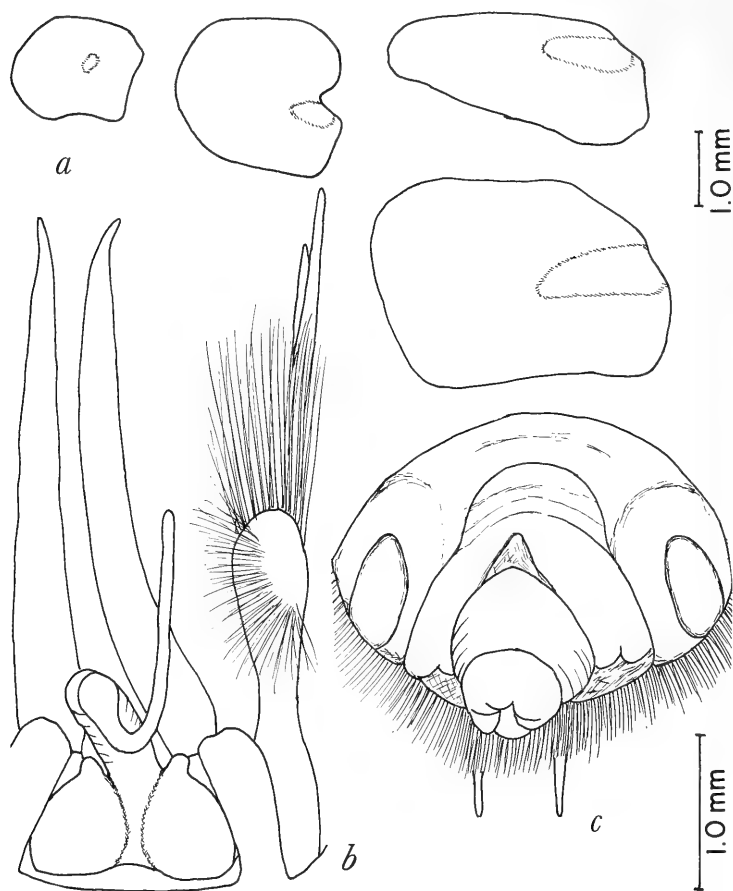


FIG. 2. *Heteraphrodita altoni*, new species. a, first four right elytra; b, dorsal view prostomium, right parapodium of first or tentacular segment, and elongated elythrophones of segment 2; c, dorsal view posterior end, including segments 25 (last elytragerous) and 26 (last cirriferous), with dorsal feltage cut open exposing the conical pygidium and anus, last pair elytra removed, tips of last pair dorsal cirri shown, projecting posteriorly.

Remarks: *Heteraphrodita* differs from the other genera of aphroditids in lacking stout protective notosetae and in lacking a distinct facial tubercle anterior to the mouth. In common with *Aphrodita*, it has a well-developed dorsal feltage completely covering the elytra. In common with *Pontogenia*, the neuropodia of the anterior few segments lack bipinnate neurosetae.

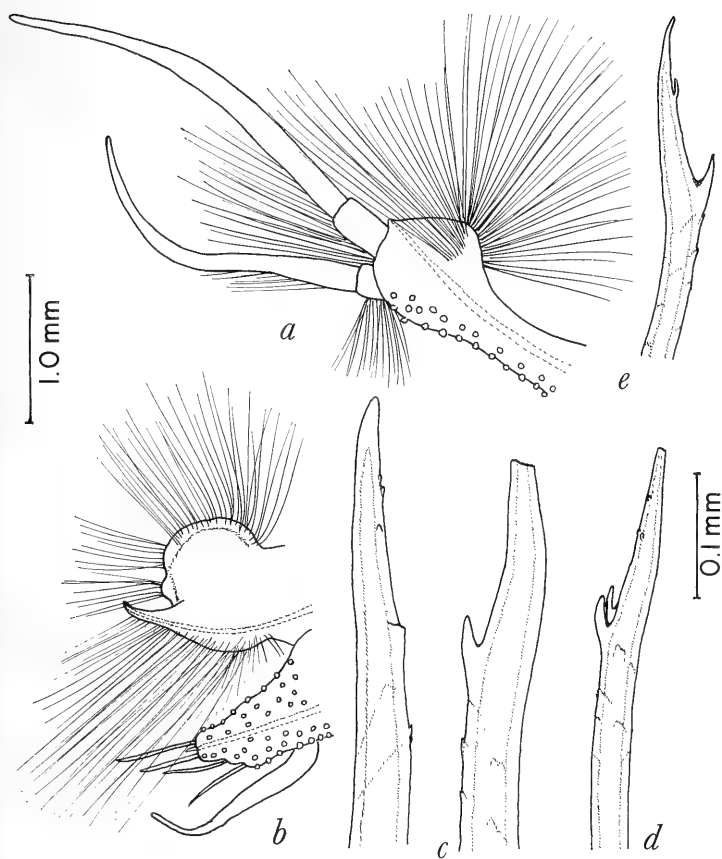


FIG. 3. *Heteraphrodita altoni*, new species. a, left parapodium of first or tentacular segment, outer or posterior view; b, right parapodium of second or buccal (first elytragerous) segment, inner or anterior view; c, tips of two upper neurosetae from same; d, tip of middle neuroseta from same; e, tip of lower neuroseta from same.

***Heteraphrodita altoni*, new species**

Figs. 1-5

The species is based on 11 specimens collected in a trawl haul by the M/V *Commando* at a single station off Oregon, southwest of the mouth of the Columbia River, 45°45'N, 125°09'W, 900 fathoms, 29 May 1964, M. S. Alton, collector. The holotype and 10 paratypes are deposited in the United States National Museum, USNM 33035 and 33034. The species is named for Mr. Miles S. Alton, who collected the specimens.

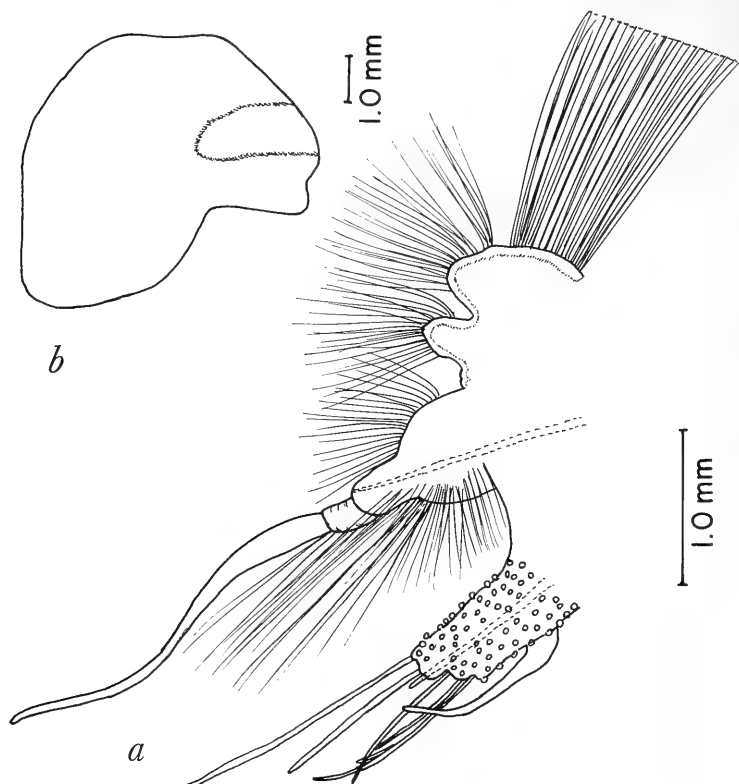


FIG. 4. *Heteraphrodita altoni*, new species. a, right parapodium of third (cirriferous) segment, anterior view (only bases of upper notopodial feltage setae shown); b, eighth right elytron.

Description: Length 17 to 28 mm, width 12 to 14 mm, segments 26, last 2 to 3 small. Body suboval, flattened ventrally, arched dorsally, rounded anteriorly and posteriorly (Fig. 1). Parapodia and ventral surface of body thickly covered with globular to capitate papillae (Figs. 3, a, b; 4, a; 5, a, b). Dorsal surface smooth, thin-walled, covered by elytra and well-developed dorsal feltage, which is uniformly covered with fine mud. Additional thick spreading bundles of short capillary notosetae, to which fine mud adheres, giving an exceedingly bushy appearance to the dorsolateral parts of the body, above and between the neuropodia.

Elytra 13 pairs, with firm muscular attachments to elytophores, on segments 2, 4, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, and 25. Elytra smooth, transparent, partly encrusted with brownish material. First pair of elytra

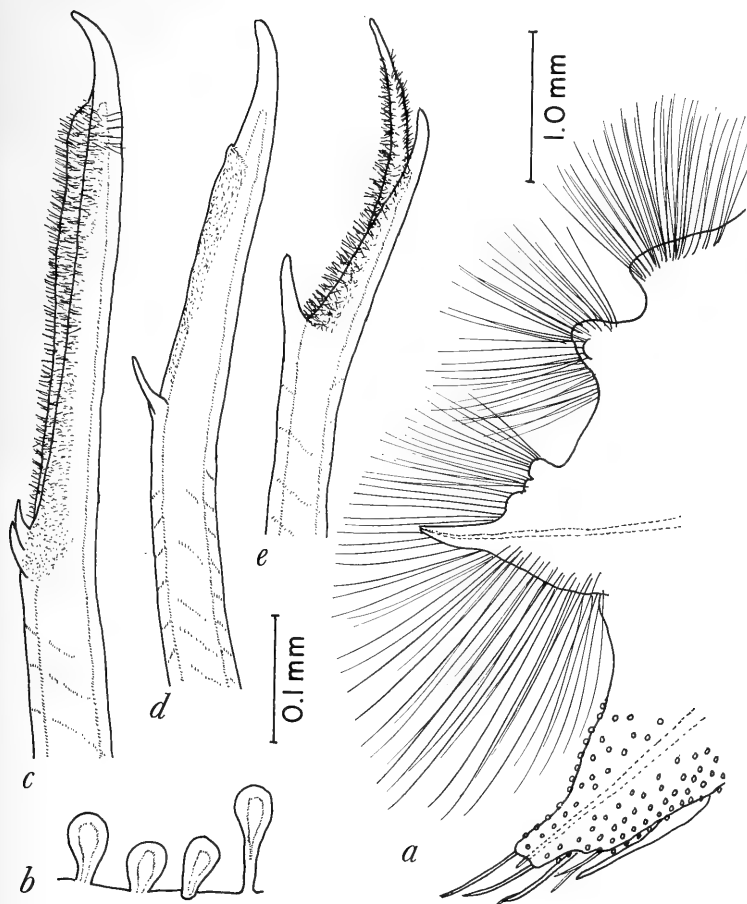


FIG. 5. *Heteraphrodita altoni*, new species. a, right parapodium of segment 15 (elytragerous), anterior view; b, few papillae from neuropodium of same; c, upper neuroseta from same; d, middle neuroseta from same; e, lower neuroseta from same.

small, rounded, with central attachment to elongated cylindrical elytophores (Fig. 2, a, b). Remainder of elytra increasing in size to middle of body, then decreasing in size posteriorly; oval areas on lateral halves of elytra indicating attachments to short elytophores. Elytra variable in shape, subrectangular, oblong to subreniform (Figs. 2, a; 4, b). Posterior 2 or 3 pairs of elytra projecting posteriorly, curling around the anal

region; their posterior tips usually visible, projecting from under the dorsal feltage.

Prostomium (Fig. 2, b) bilobed, wider than long, with middorsal raised area continuous with elongated ceratophore of median antennae; style of antenna wider basally, tapering distally; a pair of short rounded anterior ocular peduncles; no eyes visible; a pair of long stout tapering ventral palps on short basal palpophores; palps appearing smooth under low magnification but scattered, tapered papillae visible under high magnification.

Proboscis thick, muscular, without jaws, with numerous fine, branched papillae around opening. First or tentacular segment (Figs. 2, b; 3, a) with elongated uniramous parapodia projecting laterally and anteriorly to prostomium; parapodia enlarged distally, forming rounded lobes with acicula and several radiating bundles of capillary notosetae, with globular papillae along ventral sides; 2 pairs tentacular cirri, with cylindrical cirrophores on outer or posterior sides of lobes; styles elongated, tapering, upper pair longer than palps, lower pair more delicate and shorter than dorsal pair. Upper lip of mouth only slightly inflated; facial tubercle absent.

Second or buccal segment with first pair of small elytra attached on elongated elytraphores (Fig. 2, a, b). Parapodia biramous, extending anterior and lateral to mouth (Fig. 3, b). Neuropodia cylindrical, covered with globular papillae; aciculum in middle part of lobe, with distal tip projecting between the 2 upper neurosetae; neurosetae few in number (about 7), stout, in 3 rows, upper 2 setae longer, stouter, reddish-amber colored, one seta with basal tooth or spur, other seta with tooth absent or broken off (Fig. 3, c); middle neuroseta yellowish, with 2 closely approximated basal spurs (Fig. 3, d); lower 3 or 4 setae yellowish, with single basal spur, with or without additional small subdistal tooth (Fig. 3, e). Surface of basal parts of neurosetae irregularly somewhat diagonally roughened; some with irregularly distributed small tubercles; distal tips and spurs occasionally broken off. Ventral cirri wider basally, tapering distally, extending beyond tips of neurosetae, somewhat longer than the following ventral cirri. Lower parts of notopodia with projecting acicular lobes containing curved acicula tapering to slender tips; upper parts of lobes rounded, inflated; both parts encircled with short capillary setae, lower bundles of setae somewhat longer than others and extending laterally.

Third segment with first pair of dorsal cirri and biramous parapodia, lateral to mouth (Fig. 4, a). Neuropodia similar to those following, with ventral cirri extending slightly beyond tips of neuropodia. Lower parts of notopodia with subconical acicular lobes, encircled with numerous capillary setae, the lower setae longer and extending laterally; acicular lobes bearing cylindrical cirrophores of dorsal cirri; styles of dorsal cirri long, tapering, extending beyond the tips of the capillary setae; upper parts of notopodia bilobed, smaller lower lobes with short capillary setae, upper larger lobes with short capillary setae extending dorsolaterally

and bundles of long capillary setae extending mediodorsally and forming part of the dorsal feltage. Third segment forming ventral lip of mouth.

Remainder of body similar, except for differences in the feltage notosetae of the cirriferous segments (Fig. 5, a). Neuropodia cylindrical, ending distally in 3 step-like lobes, covered with scattered globular to clavate papillae (Fig. 5, b). Neurosetae stout, reddish to yellow amber-colored, arranged in 3 tiers; upper group composed of 2 setae, above and below the aciculum, the tip of which projects slightly; middle lobe with 1 or 2 shorter setae; lower lobe with 3 or 4 still shorter setae. Neurosetae of upper group (Fig. 5, c) with distally curved tip and 2 closely approximated basal spurs; between the tip and the spurs, a wide spinous sheath along the concave margin. Neurosetae of middle region (Fig. 5, d) with single basal spur, hooked tip, and poorly indicated sheath region. Neurosetae of lower region (Fig. 5, e) with single basal spur, hooked tip, and well-developed spinous sheath extending as a spinous process beyond the tip of the seta proper. Basal parts of the neurosetae diagonally roughened. Ventral cirri wider basally, tapering distally and extending nearly to tips of neuropodial lobes. Notopodia elongated dorsoventrally; lower parts forming subconical acicular lobes containing acicula; thick bundles of short capillary setae extending dorsally, posteriorly and ventrally from the acicular lobes, the ventral groups somewhat longer than the others. Two additional thick radiating bundles of short capillary setae emerging more dorsally on the notopodia. Fine mud adhering to these 3 groups of iridescent capillary setae, giving an exceedingly bushy appearance to dorsolateral regions of the body. On the cirriferous segments, in addition to the 3 groups of short capillary notosetae, compact thick bundles of long iridescent capillary notosetae emerging above the upper bundles of notosetae and fanning out anteriorly, dorsally and posteriorly; the latter portions partially overlapping the radiating bundles of notosetae of the following cirriferous notopodia. These dorsal groups of notosetae on the cirriferous segments intermeshing and forming a compact dorsal feltage to which fine mud adheres. Dorsal cirri with elongated cylindrical cirrophores located posterior to the upper bundles of short notosetae; styles of dorsal cirri long, slender, tapering, extending well beyond the notosetae.

Neuropodia of few posterior segments smaller, with fewer neurosetae—1 upper, 1 middle, and 2 lower; neurosetae with 1 or 2 basal spurs, hooked tips, and spinous sheaths more or less developed. Pygidium (Fig. 2, c) a conical lobe projecting posterodorsally, with bulbous lips around anus at summit of cone. Base of pygidium encircled by segments 25 (last elytriferous) and 26 (last cirriferous). Posterior 2 or 3 pairs of elytra projecting posteriorly, encircling the conical pygidium.

Remarks: *Heteraphrodita altoni* resembles in many respects the description and figures of *Aphrodita intermedia* McIntosh, 1885, from off West Indies, collected in 390–460 fathoms. Based particularly on the lack of notopodial protective setae and the peculiar type of neurosetae described and figured by McIntosh, *A. intermedia* is herein referred to

Heteraphrodita. The two specimens of *H. intermedia* described by McIntosh were considerably smaller than the specimens of *H. altoni* (about 5 mm long and about half as wide in the former, compared with length of 17–28 mm and width of 12–14 mm in the latter). Prostomium lacks ocular peduncles in *H. intermedia*, according to McIntosh, although it was stated that the specimens were softened, making it difficult to observe the prostomial structures; short rounded ocular peduncles are present in *H. altoni*. Only one type of neurosetae was described and figured for *H. intermedia*—neurosetae with basal spurs, hooked tips, and with translucent filiform densely pilose processes projecting beyond the hooked tips (McIntosh, 1885, pl. 6A, Fig. 1); in *H. altoni*, this type is mainly confined to the lower row of neurosetae (Fig. 5, e); in the middle and upper series, there may be 1 or 2 basal spurs, and the hairy sheaths along one side of the setae do not extend up to the hooked tips. However, the differences may be correlated with age and size of the animals.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW CRAYFISH FROM ALABAMA WITH
OBSERVATIONS ON THE CRISTATUS SECTION OF
THE GENUS *CAMBARUS* (DECAPODA, ASTACIDAE)

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The new species described below is assigned to the previously monotypic *Cristatus* Section of the genus (Hobbs, 1955: 98). This section was erected to receive the unique *Cambarus cristatus* Hobbs from eastern Mississippi which exhibits a combination of characters shared only with this new crayfish from Alabama.

GENUS *CAMBARUS* ERICHSON, 1846
CRISTATUS SECTION

Diagnosis: Rostrum broadly ovate and subspatulate. Areola 4.6-7.5 times longer than broad and constituting 31-35.5 percent of total length of carapace. Cervical spines (or tubercles) and suborbital angles lacking. Antennal scale approximately one-half as broad as long with lamellar portion much broader than lateral thickened area. Sternum of first form male with conspicuous, setiferous, ventrally projecting prominences. Mesial process of first pleopod of male slender and projecting much farther caudad than central projection. Annulus ventralis joined cephalically to sternum by flexible membrane.

Range and habits: Both species of the Section occur within the watershed of the Tombigbee River. *Cambarus cristatus* is known from Lowndes, Noxubee, Kemper, and Lauderdale counties, Mississippi, and the new species from Sumter County, Alabama. Whether the river is effective in serving as a barrier between the two species is not definitely known but the single known locality for *C. prominens* is on the east side of the river, whereas *C. cristatus* is found west of it.

If indeed the Tombigbee River or its adjacent well-drained banks is acting as a barrier between these two secondary burrowing crayfishes, it is not unique in doing so, for it has been pointed out (Hobbs, 1942) that the Altamaha River in Georgia separates the ranges of the closely related *Procambarus barbatus* (Faxon, 1890: 621) to the north and *Procambarus pubischelae* Hobbs (1942: 41) to the south.

Presumably *C. prominens*, like *C. cristatus*, is a secondary burrower. All of the available specimens were dug from burrows in a drying roadside ditch.

***Cambarus prominens*¹ new species**

Diagnosis: Rostrum subplane or slightly excavate, ovate, without marginal spines or tubercles. Areola 4.6–5.7 times longer than broad and constituting 33–35.5 percent of entire length of carapace. Suborbital angle lacking. Postorbital ridges without spines or tubercles. Antennal scale more than one-half as broad as long. Chela with cristiform row of tubercles on mesial margin of palm. First pleopod of first form male with central projection directed at approximately a 110-degree angle to main shaft of appendage, and slender mesial process at a 100-degree angle. Annulus ventralis freely movable (see Fig. 2).

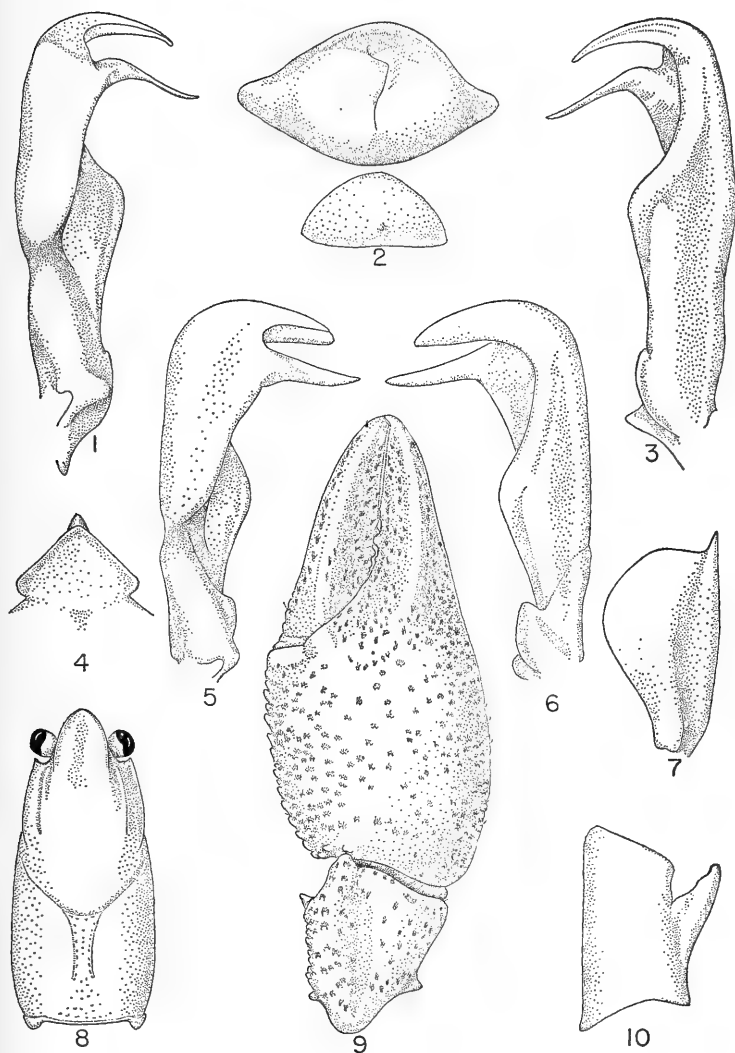
Holotypic male, form I: Body subovate, compressed laterally. Abdomen narrower than thorax (7.2–9.1 mm in widest parts respectively). Width of carapace less than depth in region of caudodorsal margin of cervical groove (9.1–9.8 mm). Areola moderately broad (5 times longer than wide), with row of punctations mesial to each branchiocardiac groove and median longitudinal row in cephalic portion, only three punctations across narrowest part. Cephalic section of carapace 1.8 times as long as areola (length of areola 35.5 percent of length of carapace). Rostrum equal in length and width, subspatulate, and without an acumen; cephalic extremity reaching penultimate podomere of antennular peduncle; margins not swollen, only slightly elevated, lacking marginal spines or tubercles. Upper surface subplane, only slightly depressed medially; surface with many punctations, most of them bearing fine setae. Subrostral ridges weak but evident in dorsal aspect along caudal half of rostrum.

Postorbital ridges well developed, long, with lateral punctations fusing cephalically to form longitudinal groove; cephalic ends without tubercles or spines. Suborbital angle lacking. Branchiostegal spines reduced to small tubercles. Cervical (lateral) spines and tubercles immediately caudal to cervical groove lacking. Carapace punctate dorsally and cephalolaterally, punctations particularly conspicuous in area immediately mesial to postorbital ridges; lateral portions of branchiostegites granulate. Abdomen longer than carapace (22.6–20.0 mm). Cephalic section of telson with five spines in each caudolateral corner; four mesial ones in each group much smaller than lateral one.

Epistome (Fig. 4) subtriangular with elevated (ventrally) margins and small cephalomedian extension. Antennules of usual form with small spine on lower surface of basal segment; mesial setal fringe of peduncle conspicuous. Antennae broken but probably extending no farther caudad than base of abdomen. Antennal scale (Fig. 7) broader in distal than in proximal half; slightly more than one-half as broad as long; outer thickened portion narrower than lamellar area and terminating distally in prominent spine.

Chela (Fig. 9) with palm broad and only slightly inflated, length of

¹ *L. prominens*—prominent; so named because of the prominent mesial process of the first pleopod and the sternal processes of the first form male.



FIGS. 1-10. *Cambarus prominens*, sp. nov. 1, Mesial view of first pleopod of holotype; 2, Annulus ventralis of allotype; 3, Lateral view of first pleopod of holotype; 4, Epistome of holotype; 5, Mesial view of first pleopod of morphotype; 6, Lateral view of first pleopod of morphotype; 7, Antennal scale of holotype; 8, Dorsal view of carapace of holotype; 9, Distal podomeres of cheliped of holotype; 10, Ischiopodite of third pereopod of holotype.

mesial margin of palm equal to width; dorsal surface of palmar area with crowded setiferous squamous tubercles mesially and laterally, medial portion with deep setiferous punctations; lower surface of palm punctate, inner margin with cristiform row of 18 tubercles; left chela with 16 tubercles; fingers not gaping; dorsal and ventral surfaces of both fingers with submedian longitudinal ridge flanked by setiferous punctations; ridges on upper surfaces more prominent; no tubercles present on ventral surface of palm at base of dactyl; opposable margin of dactyl with 4 tubercles along proximal two-fifths, distalmost largest; mesial margin subcostate with row of setiferous punctations; opposable margin of immovable finger with three tubercles along proximal third of which distalmost largest, but smaller than larger tubercle at midlength; proximal of two large tubercles lying dorsal to row on dactyl when fingers appressed while distal one situated ventral to it; crowded minute denticles between and distal to tubercles on both fingers; lateral margin of immovable finger subcostate with lateral groove bearing row of deep setiferous punctations.

Carpus of cheliped longer than broad; dorsal surface provided with oblique groove, tuberculate mesiodorsally, otherwise with setiferous punctations; like *Cambarus cristatus*, with only two tubercles on podomere conspicuously larger than others, that on mesial surface distal to midlength and other at distal ventrolateral margin. Upper and mesial surfaces of merus punctate proximally and tuberculate distally; lateral surface entirely punctate, all punctations and tubercles with setae; lower surface with mesial row of 15 tubercles and lateral one with irregular row of 10, both rows flanked by a few additional tubercles. Mesial margin of ischiopodite with row of six tubercles.

Maxillipeds and coxae of second through fifth pereopods heavily setose.

Ischiopodites of third pereopods with hooks simple but strong and extending proximally to distalmost portion of basipodite (Fig. 10). Coxae of fourth pereopods with small caudomesially projecting prominence, those of fifth pereopods with prominent tubercle lying cephaloventral to penis and even more conspicuous one lying ventrolateral and slightly caudal to penis. Sternal projections at bases of coxopodites heavily setiferous and as conspicuous as those of *Cambarus cristatus*.

First pleopod (Figs. 1 and 3) reaching to coxopodites of third pereopods when abdomen is flexed and lying deeply embedded between ventrally projecting sternal projections; distal portion terminating in two parts; central projection corneous, with tip subacute, bent caudally at angle of approximately 100 degrees to main shaft of appendage; mesial process non-corneous, slender, and directed subparallel to central projection; mesial process conspicuously longer than central projection; both terminal elements directed slightly mesially.

Morphotypic male, form II: Differs from the holotype in the following respects: Rostrum distinctly longer than broad, with short acumen reaching distal end of peduncle of antennule; upper surface more setose; areola 5.8 times longer than broad and constituting only 33.5 percent

of entire length of carapace; cephalic section of telson with three spines in each caudolateral corner; usual differences occur in secondary sexual characters—reduced hooks on third pereopods and slightly reduced prominences on coxae of fourth and fifth pereopods.

First pleopod (Figs. 5 and 6) reaching base of third pereopods, both processes non-corneous and directed at angles only slightly less than in holotype; juvenile suture near base prominent; central projection directed slightly mesially and mesial process slightly laterally.

Allotypic female: Rostrum as in morphotype with distinct acumen and longer than broad, apex approaching distal extremity of peduncle of antennule; areola 4.6 times longer than broad and constituting 33.5 percent of carapace; cephalic section of telson with three spines in each caudolateral corner. Mesial margin of palm of chela with row of 13 tubercles; opposable margin of dactyl with two tubercles along proximal two-fifths of finger, and corresponding margin of immovable finger with two tubercles along proximal half, distal one lying under dactyl and proximal one above it when fingers meet; merus of cheliped with ventromesial row of 13 tubercles and ventrolateral one of nine; mesial margin of ischiopodite with five tubercles.

Annulus ventralis freely movable; cephalomedial portion with deep depression bordered cephalically by slightly elevated (ventrally) rim; caudal three-fourths highly elevated and inflated and bearing a 7-shaped sinus; sinus originating in cephalic depression slightly dextral to median line, curving caudosinistrally across line, there making approximately 90-degree angle and continuing caudodextrally along inflated portion, terminating some distance cephalic to caudal margin of annulus. Sternal plate immediately caudal to annulus evenly contoured, rounded cephalically, with small tubercle on median line near caudal margin.

Measurements: As follows (in mm):

| | <i>Holotype</i> | <i>Allotype</i> | <i>Morphotype</i> |
|---|-----------------|-----------------|-------------------|
| Carapace | | | |
| Height | 9.8 | 8.4 | 6.7 |
| Width | 9.1 | 18.7 | 7.0 |
| Length | 20.0 | 19.1 | 15.5 |
| Areola | | | |
| Width | 1.4 | 1.4 | 0.9 |
| Length | 7.1 | 6.5 | 5.2 |
| Rostrum | | | |
| Width | 4.0 | 3.7 | 2.8 |
| Length | 4.0 | 4.4 | 3.8 |
| Chela | | | |
| Length of mesial margin of palm | 6.4 | 3.9 | |
| Width of palm | 6.4 | 4.2 | |
| Length of lateral margin of chela | 13.8 | 9.2 | |
| Length of dactyl | 7.4 | 5.4 | |

Color notes (holotypic male): Carapace purplish red with very dark splotches in area of attachments of mandibular muscles and pair of similarly colored longitudinal bars along cephalic half of branchiocardiac grooves. Ventral portions of branchiostegites lighter in color than dorsal area. Abdomen dark vermillion with pair of longitudinal, dorsolateral black bands extending from base of abdomen caudally to cephalic portion of sixth segment; epimera reddish tan. Telson and uropods pinkish straw; cephalic half of former bounded laterally and caudally by narrow band of dark brownish red; similar bands along lateral margin of mesial ramus of uropod and across distal articular line of lateral ramus. Cheliped mostly tan with black splotch on dorsal surface of palm proximal to lateral base of dactyl; medial, proximal, and lateral portions of dorsal surface of palm darker than middorsal area and fingers; dorsal surface of carpus similar to that of palm and darker area almost black. Legs brownish dorsally fading to pinkish tan ventrally; proximal two podomeres also pinkish tan.

Type-locality: Roadside ditch, three miles west of Demopolis, Sumter County, Alabama, on U. S. Rte. 80. The ditch contained sedges, grasses, and *Saururus cernuus*; dominant trees in the vicinity included *Pinus*, *Acer*, *Liriodendron*, and *Quercus*. On 18 April 1965, when the collection was made the ditch was almost dry, hundreds of tadpoles were stranded in the few remaining pools, and crayfish burrows riddled the sandy clay soil. The latter was so pliable that the burrows could be dug without the use of trowel or shovel. A few of the burrows higher on the bank, presumably those of *Cambarus d. diogenes* Girard (1852: 88), were more than two feet deep, but most were less than a foot in depth. All of the shallower ones were simple, straight, and vertical or slightly inclined.

Other crayfishes associated with *Cambarus prominens* in the ditch were *Procambarus hybus* Hobbs and Walton (1957: 39), *P. acutus acutus* Girard (1852: 91), and *Cambarus diogenes diogenes* Girard.

Disposition of types: The holotypic male, form I, the morphotypic male, form II, and the allotypic female are deposited in the United States National Museum (nos. 115603, 115604, and 115605, respectively). Of the four paratypes, one male, form I, and a female are deposited in the Museum of Comparative Zoology and two females are in the U. S. National Museum.

Variations: The most conspicuous variation is in the areola; in the morphotype it appears to be much narrower than in the other specimens. The apparent greater length in the holotype (see measurements), in which it constitutes 35.5 percent of the length of the carapace, however, is not due to its length but rather to the short rostrum which lacks an acumen, thereby giving a higher ratio. In the remaining specimens the areola does not exceed 34.8 percent of the length of the carapace. There are slight differences in tubercle counts and in the numbers of spines but most of these are within the range of variations noted in the accounts of the allotypes and morphotype.

Relationships: In assigning *Cambarus prominens* to the previously monotypic *Cristatus* Section of the genus, it is obvious that *Cambarus cristatus* is considered to be its closest relative. It may be distinguished from *C. cristatus* by its longer areola, constituting 33 to 35.5 percent of the length of the carapace as opposed to less than 33 percent (in 40 adults), and the more strongly bent terminal elements of the first pleopod of the first form male—central projection 110 degrees and mesial process 100 degrees as opposed to 65 and 90 degrees respectively. The characters shared by the two are summarized in the diagnosis of the Section. Several observations on these characters are pertinent.

The generalization has been made that most crayfishes occupying temporary bodies of water or burrows have narrow and, most frequently, long areolae. Exceptions to this were known when the generalization was made, and the two members of this Section join most *Cambarellinae*, most members of the *Barbatus* Section (Hobbs, 1942: 33) of the genus *Procambarus*, *P. hinei* (Ortmann, 1905: 401) and the two members of *Faxonella* in providing exceptions to the generalization. What morphological and physiological mechanisms are involved in this are not known.

The absence of cervical spines or tubercles may be correlated with the burrowing habit, for all habitual burrowers have these eminences reduced or obsolete.

The broad antennal scale, found elsewhere in the genus *Cambarus* only among the troglobitic members (Hobbs and Barr, 1960), is associated with the broad rostrum which provides shelter beneath it for the wide lamellar portion.

The broad, flat rostrum without marginal spines or tubercles is typical of many of the secondary burrowers (Hobbs, 1942: 20), *e.g.*, the *Barbatus* Section of *Procambarus* and *Faxonella*, but is unique in the genus *Cambarus*.

The conspicuously large setiferous sternal processes in the male have not been observed in other crayfishes but it is obvious that without extending the sternal processes or in some way deepening the sternum to receive the first pleopods, the tips of the mesial processes would be exposed and, if so, could easily be injured, particularly during the construction of burrows. Thus there seems to be an association of the long recurved mesial process and the "protective" setiferous sternal projections. An elongate mesial process is also found in *Cambarus asperimanus* Faxon (1914: 391), *C. conasaugaensis* Hobbs and Hobbs (1962: 41), *C. fodiens* Cottle (1863: 217), *C. uhleri* Faxon (1884: 116), *C. hedgpethi* Hobbs (1948: 224), and *C. oryktes* Penn and Marlow (1959: 197). In the latter four it is slender as in *C. cristatus* and *C. prominens*; however, in all of them it is twisted, and in none does it project relatively so far caudad in relation to the central projection.

The freely movable annulus ventralis is characteristic of the *Cambarellinae*, most *Procambarus*, *Troglocambarus*, *Paracambarus*, and some *Cambarus* but rare in *Orconectes*.

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Simpson, and George Tate, all of Louisiana State University, for assisting me in collecting the crayfish on which this description is based.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NATURAL HISTORY OF
PLUMMERS ISLAND, MARYLAND¹

XIX. ANNOTATED LIST OF THE APHIDS (HOMOPTERA: APHIDIDAE)

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On 27-28 July 1912, while enroute to New York from participation in the Cornell Okefenokee Expedition in Georgia, I visited Plummers Island with Harry L. Viereck. This was a never-to-be-forgotten experience for a young entomologist who had just finished his junior year at Cornell. On the Island I met and collected with the late Herbert S. Barber, E. A. Schwarz, A. K. Fisher, Waldo L. McAtee, and several others whose names have unfortunately escaped me. At that time I had no interest in aphids and, so far as I know, neither did McAtee. However, in 1913-1914 he made about 50 collections of aphids which he sent to Edith M. Patch of the Maine Agricultural Experiment Station for determination. About two years before his death McAtee wrote me about this activity. Through the kindness of W. Geddes Simpson of the Maine Agricultural Experiment Station I have been able to borrow Miss Patch's notes on these collections.

The material collected in the island by McAtee forms the basis for this paper. This was supplemented by several collections made from plants on the island itself and by a few made from plants on the Maryland shore opposite Plummers Island by other members of the Biologists' Field Club in recent years. During the period 1957-1964 Karl V. Krombein of the U. S. Department of Agriculture collected a few aphids in

¹ The preceding number in this series was published in Proc. Biol. Soc. Wash. 77: 73-112, 18 Figs., 1964. Publication costs of the present number have been defrayed by the Washington Biologists' Field Club to promote its primary objective of research on the fauna and flora of Plummers Island and adjacent areas.

connection with his biological studies of predaceous solitary wasps or from aphid food plants. Paul J. Spangler of the U. S. National Museum made several aphid collections in 1961-1962, and George B. Vogt of the U. S. Department of Agriculture made a fair number of collections in 1964, and a larger number in 1965.

Representatives of the specimens collected by McAtee were put on slides by Miss Patch and are in the Department of Entomology, Maine Agricultural Experiment Station, Orono, Maine. However, Dr. Simpson of that institution was unable to locate slides of the aphids listed in this paper in the genera *Dactynotus*, *Macrosiphoniella* and in *Macrosiphum* (except in two cases) to send to Dr. Olive for verification. All the other and more recent collections are represented by slides in the collection of the author.

The total number of aphids determined definitely to species is 48. Six additional species were identified provisionally, and nine other species to genus only. Forty four of the aphids determined specifically were taken on Plummers Island and four were from the Maryland mainland opposite the island. Collections were made from 49 host plants. Intensive collecting would surely reveal many more aphid species on many other plants.

If not otherwise designated, all collections were made by McAtee and determinations by Patch.

My thanks are due to Dr. Simpson for the loan of Miss Patch's notes on the McAtee collections and for sending some of the slides for determination or verification to J. O. Pepper, Pennsylvania State University, A. N. Tissot, University of Florida and A. T. Olive of Wake Forest College. Thanks are due the following for determinations of insects associated with the aphids: C. W. Sabrosky (chloropid flies), J. L. Herring (anthocorid bugs), D. R. Smith (ants), all of the Entomology Research Division, U. S. Department of Agriculture; O. S. Flint (larvae of a chloropid and of a hemerobiid), Department of Entomology, Smithsonian Institution; and the late C. H. Seevers (staphylinid beetles), Research Associate, Chicago Natural History Museum. I am also indebted to C. F. Smith, North Carolina State University, and Louise M. Russell, U. S.

Department of Agriculture, for determining some of the aphids collected in recent years. Miss Russell also kindly reviewed the manuscript of this paper. Stanwyn G. Shetler, Department of Botany, U. S. National Museum, was kind enough to determine some of the plants.

An excellent account of the life and work of Waldo Lee McAtee was published by his long-time associate, E. R. Kalmbach (1963).

LIST OF APHIDS

Acyrtosiphon pisum (Harris), pea aphid. 28 May 1914, accidental on *Acer saccharinum*.

Anuraphis viburniphila Patch, viburnum aphid. 24 May 1914 on stem of *Viburnum acerifolium*. This material was included as "cotypes" in the original description by Patch (1917: 416).

Aphis cephalanthi Thomas. 4 July 1914 on stems and peduncles of *Cephalanthus occidentalis*. 14 June 1964 on stems of *C. occidentalis* (Vogt, coll.; Leonard, det.).

Aphis folsomii Davis. 28 June 1914 on stems and leaves of *Parthenocissus quinquefolia*.

Aphis heraclella Davis, wild parsnip aphid. 1 November 1964, 2 males, 4 or 5 oviparae, several apterae, including several parasitized "mummies" on *Cryptotaenia canadensis* (Shetler, det.) and 8 August 1965, a considerable number of apterae and alatae on several stems of the inflorescence of *C. canadensis*; many parasitized but no parasites emerged; attended by the ant, *Lasius alienus* (Foerster) (D. R. Smith, det.)—(Vogt, coll.; Russell, det.).

Aphis illinoisensis Shimer, grapevine aphid. 24 May on *Viburnum prunifolium* and *Vitis vulpina* and 28 June on *Vitis rotundifolia*, on stems and leaves, 1914. 24 May 1914 on *Vitis vulpina* (G. A. Lawyer, coll.; Mason, det.). 28 June 1961, on *Vitis* sp. (Spangler, coll.; Leonard, det.).

Aphis impatientis Thomas. 16 August 1914, apterae on leaf of *Impatiens pallida*.

Aphis monardae Oestlund. 4 July 1914 on stems and underside of involucre bracts of *Monarda punctata*.

?*Aphis oenotherae* Oestlund. 14 July 1914 on upper leaves of *Oenothera biennis*; determined with query since only apterae were present.

Aphis rumicis Linnaeus, dock aphid. 24 May 1914 on *Rumex crispus*.

Catomegus fulvae (Oestlund). 14 September 1913, 2 alatae on *Impatiens biflora* and (number of specimens not given) 16 August 1914 on terminal branches of *I. pallida*.

Chaitophorus populicola (Thomas), cloudy-winged cottonwood leaf aphid. 9 August 1914 on *Populus deltoides*. On 24 September 1959 a female of the wasp *Passaloecus annulatus* (Say) was captured carrying a winged specimen of this aphid (Russell, det.; Krombein, 1961: 65).

7 July 1964, 1 alate and a few very young on cottonwood (Vogt, coll.; Leonard, det.). 4 August 1965, a number of apterae and alatae on a shoot of *Populus grandidentata* in Maryland near Plummers Island (Vogt, coll.; Leonard, det.); many attended by ants, *Formica fusca* L. (D. R. Smith, det.); also 8 August 1965, attended by the ant *Camponotus pennsylvanicus* (DeG.) (D. R. Smith, det.).

Chaitophorus populicola patchae Hille Ris Lambers. On 27 July 1961 a series of 8 cells in a nest of the wasp *Pemphredon (Cemonus) lethifer* form *littoralis* Wagner were found to contain approximately 100 aphids, mostly nymphs but also a few winged viviparae, of this aphid (Russell, det.; Krombein, 1964: 99).

Chaitophorus viminalis Monell, little black and green willow aphid. 4 July and 2 August 1914 on stems and upper leaves of *Salix nigra*.

Cinara junipivora (Wilson). 5 July 1914 "Beaten from foliage of *Juniperus virginiana*." These specimens constitute the holotype and paratypes of a new species described in *Lachnus* by H. F. Wilson (1919: 6). The specimens were labeled by Patch as "*Lachnus* n. sp."

Cinara pergandei (Wilson). 27 September 1960 on *Pinus* sp. (Spangler, coll.; Tissot, det.).

Cinara taedae Tissot. 16 August 1913 on *Pinus virginiana* (Tissot and Pepper, det.).

Colopha sp. 11 July 1964, nymphs from a small gall on upper surface of each of two leaves of American elm. (Vogt, coll.; Smith, det.).

Colopha ulmicola (Fitch), elm cockscomb gall aphid. 1914 (no specific date), "a cockscomb gall on leaves of *Ulmus americana*." (This was determined by Patch as *Tetraneura graminis* Monell.)

?*Dactynotus ambrosiae* (Thomas), brown ambrosia aphid. 16 August 1914 on stem of *Solidago* sp. and 23 September 1914 among inflorescence of *Solidago* sp. (Patch det. as *Macrosiphum solidaginis*). Although slides could not be found in the Patch collection so that Olive could verify the determination, it is quite probable that *ambrosiae* is correct for it has been recorded authentically from *Solidago* sp. several times elsewhere.

?*Dactynotus rudbeckiae* (Fitch), goldenglow or coneflower aphid. 28 June 1914 on stem of *Rudbeckia laciniata*. Patch's determination has not been verified by Olive since no slide could be found.

Dactynotus ruralis (Hottes and Frison). 28 May 1914 on *Verbesina virginica* (the name *virginica* in this instance is erroneous and should be *occidentalis*) (Olive det., from slides labeled *Macrosiphum* n. sp. by Patch). 24 May and 4 July 1914 on *Verbesina* sp. (Olive det., from slides labeled *Macrosiphum* n. sp. by Patch). 24 July 1960 (Krombein, coll.) and 7, 13 June, 1 July 1961 (Spangler, coll.) (both Olive det.), on *Verbesina (Actinomeris) occidentalis*. 18 October 1964 on *V. alternifolia*, a partly-grown larva of a hemerobiid, probably *Micromus* sp. (O. S. Flint, det.) was found feeding in a colony of the aphids. 1 November 1964, a few apterae and 1 alata on the top of a plant of *V. alternifolia* (Vogt, coll.; Leonard, det.). 11 November 1964, several in all stages on *V. alternifolia* (Vogt, coll.; Olive, det.). 10 October 1965, about 40 apterae

of all sizes and 1 alata on upper part of stem of *V. alternifolia* (Vogt, coll.; Leonard, det.).

Drepanaphis sp. On 21 August 1957 three wasps, *Stigmus* (S.) *americanus* Packard, were taken with paralyzed aphid nymphs (Russell, det.). On 3 September 1957 the wasp *Passaloecus annulatus* (Say) was taken with an aphid (Russell, det.; Krombein, 1958: 24).

Drepanaphis acerifolii (Thomas). 24 May and 14 August 1914 on *Acer saccharinum* (det. verified by Tissot and Pepper). 17 July 1961 on *Acer* sp., an alate collected by "beating trees" (Spangler, coll.; Tissot, det. with query). 28 June 1964 on suckers of silver maple (Vogt, coll.; Smith, det.).

Drepanaphis parvus Smith. 16 August 1914 on *Acer saccharinum* (Tissot and Pepper, det.). 17 July 1961 2 alatae collected by "beating trees" (Spangler, coll.; Tissot, det. with query).

Drepanaphis near *parvus* Smith, probably n. sp. 25 June 1964 on suckers of silver maple. (Vogt, coll.; Smith, det.).

? *Drepanaphis sabrinae* Miller. 27 September 1960, 1 alate collected by "beating trees" (Spangler, coll.; Tissot, det. with query).

? *Drepanaphis spicatum* Smith. 27 September 1960, 1 alate collected by "beating trees" (Spangler, coll.; Tissot, det. with query).

Eriosoma americanum (Riley), woolly elm aphid. 24 May 1914 on leaves of *Celtis canadensis*, "pupae" and an alata present. Patch noted "evidently on *Celtis* by accident." Also but without specific date "aphids in pockets on underside of curled leaves of *Ulmus americana*; young are woolly." 27 June 1965, on *Amelanchier* sp. (Vogt, coll.; Smith, det.).

Essigella californica (Essig). 24 May and 28 June, 1914, beaten from foliage of *Pinus virginiana* (Hottes, det.).

Eulachnus sp., Patch det. as n. sp. 9 May, 8 June 1913; and 28 June, 5 July 1914, beaten from foliage of *Pinus virginiana*. Patch noted that this material was sent to Wilson but I cannot find that he described it.

Hormaphis hamamelidis (Fitch). 7 June 1914, conical gall on leaves of *Hamamelis virginiana*.

Hysteroneura setariae (Thomas), rusty plum aphid. 1914, probably August, on leaf of *Echinochloa crusgalli*. Patch, who placed it in *Aphis*, noted "no winged forms but determination seems safe."

Longistigma caryae (Harris), giant bark aphid. 18 May and 5 October 1913 on *Quercus rubra*, and caught flying near Plummers Island 24 May 1914.

Macrosiphoniella eupatorii (Williams). 13 September 1914, below inflorescence of *Eupatorium rugosum* (given as *ageratoides*).

Macrosiphum sp., Patch det. as n. sp.; no slides available. 16 August 1914, an apterus viviparous female in inflorescence of *Solidago* sp. This is probably a *Dactynotus* (teste Leonard).

Macrosiphum sp., Patch det. as n. sp.; no slides available. 5 October 1913 and 19 July 1914 on stem of *Polymnia canadensis*. This and the next species could be *M. zinzalae* Hottes and Frison—no slides are available for verification.

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Macrosiphum sp. 13 September 1914 on inflorescence of *Polymnia uvedalia*.

Macrosiphum euphorbiae (Thomas), potato aphid. 7 June 1914 on *Apocynum cannabinum*.

Macrosiphum impatientis (Williams). June 1914 on stem and leaves of *Impatiens pallida* and apterae only on leaf of *I. pallida*. 17 June 1913 on *I. biflora*.

Macrosiphum liriodendri (Monell), tuliptree aphid. 30 May 1964 on tuliptree on mainland near Plummers Island (Vogt, coll.; Leonard, det.).

Masonaphis (Ericobium) pepperi MacGillivray. 19 July 1961, several alatae and apterae on *Vaccinium* sp. (Spangler, coll.; Tissot, det.).

Microparsus variabilis Patch. 9 August 1914 on stem, petioles and leaves of *Desmodium* sp.

Monellia costalis (Fitch), black-margined aphid. 27 September 1960, several alatae collected by "beating trees" (Spangler, coll.; Leonard, det.).

Myzocallis bella (Walsh). 19 July 1914 on *Quercus* sp. (Tissot and Pepper, det.). 1914 (no specific date given) on leaves of *Q. rubra* and *Q. alba*. 20 September 1914, beaten from foliage of *Quercus* sp. (det. verified by Tissot and Pepper). 4 October 1914, beaten from foliage of *Q. rubra* (det. verified by Tissot and Pepper). 14 June 1964, 1 alate on *Q. rubra* (Vogt, coll.; Tissot, det.).

Myzocallis discolor (Monell), eastern dusky-winged oak aphid. 30 May 1964, abundant on *Quercus rubra* (Vogt, coll.; Leonard, det.).

Myzocallis punctata (Monell), clear-winged oak aphid. 30 May 1964, 5 alatae, 3 nymphs on *Quercus alba* on mainland near Plummers Island (Vogt, coll.; Leonard, det.).

Myzocallis walshii (Monell). 30 May 1964, a few on *Quercus alba* on mainland near Plummers Island and 14, 22 June 1964, a few on *Q. rubra* (Vogt, coll.; Tissot, det.).

Myzus persicae (Sulzer), green peach aphid. 23 November 1913 on *Ptelea trifoliata*.

Pemphigus sp. 7 June 1914 from a gall at base of leaf of *Populus deltoides*.

Pemphigus populitransversus Riley, poplar petiole gall aphid. 17 October 1960 (Krombein, coll.; Leonard, det.) and July 1961 (Spangler, coll.; Tissot, det.), in galls on *Populus deltoides*.

Between 3 June and 10 October 1965 Vogt collected over 300 galls of this aphid on cottonwoods. Almost all of these were on fallen leaves because the branches were too high to reach. There were 12 collections between 3 June and 16 August and a final one on 10 October, ranging from about 15 to 75 galls in each. Some galls were fairly fresh and contained many live apterous and alate aphids. Other galls were rather dry, but most of them contained live aphids even though some were in a partially deteriorated condition. Almost two-thirds of the galls had been eaten out clean through a large hole in the side; this occurred also during 1964. It is suspected that this may have been the work of birds. The few fresh galls taken from the trees were not eaten out.

From one gall each collected on 13 and 18 July a staphylinid beetle ran out very rapidly when the gall was opened wide. These were determined by Charles H. Seevers as *Tachyporus* sp. They may have been scavengers.

Predators were found inside galls during both 1964 and 1965 as follows:

Anthocoridae—On 18 October 1964 Vogt collected a number of galls in which 4 anthocorid bugs were found. Two of these galls were also filled with aphids in all stages. These were determined by Jon L. Herring as *Anthocoris musculus* (Say). In 1965 in July and August this bug was found in galls collected from cottonwood by Vogt as follows: 18 July, 1 nymph; 25 July, several specimens; 8 August, 2 adults (1 male, 1 female, 1 dead, 1 alive), each in a separate gall along with 4 cast skins and 1 live nymph; 16 August, 4 adults, 3 nymphs and 5 or 6 cast skins. There were usually only one or two specimens per gall. On 10 October Vogt collected 48 uneaten galls all of which were dry inside except for one which contained a few live young and 6 alate aphids. Inside these galls were found 5 nymphal cast skins and one large live nymph of the anthocorid, one specimen to a gall except for one which contained two cast skins. It is presumed that these bugs were feeding on the aphids.

Chloropidae—During 1964 Vogt collected leaves with galls of this aphid on *Populus deltoides* as follows: 11 July, one larva of a chloropid fly in a gall containing live aphids; 19 July, a gall on a fallen leaf containing 3 chloropid larvae but no aphids; 11 October, 1 chloropid larva in a gall; 15 October, 2 chloropid larvae and 2 puparia in a gall; 18 October, 2 chloropid larvae and 4 puparia in 2 galls; 1 November, 1 half-grown chloropid larva in one of about a dozen old galls on fallen leaves. Dipterous larvae in several stages of growth were found in some of the galls collected by Vogt in 1965. These were determined as *Chloropidae* by Sabrosky. Their chronological distribution is as follows: 3 June, 1 larva; 6 June, 2 or 3 larvae in 1 gall; 6 July, 1 larva; 13 July, 2 larvae; 18 July, 3 larvae in 1 gall; 25 July, 4 larvae in 1 gall among only partly live and moist aphids. Most of the galls containing larvae were placed in small dry vials; only one fly larva transformed to an adult on 27 August. It was determined as *Chaetochlorops inquilinus* (Coquillett) by Sabrosky. On 23 July a newly emerged chloropid fly was found inside a gall; positive identification was impossible, but Sabrosky believed it to be *Siphonella nigripalpus* Malloch.

Periphyllus negundinis (Thomas), boxelder aphid. 8 May 1914 on *Acer negundo*. 16 May 1965 on *A. negundo* (Vogt, coll.; Leonard, det.).

Phyllaphis sp. 11 May 1965, in tightly curled leaves of *Fagus grandifolia*, on mainland near Plummers Island (Vogt, coll.; Smith, det., who notes "The genus *Phyllaphis* needs to be worked on carefully before we can be sure of the number of species we have.").

Prociphilus corrugatus (Sirriner), woolly hawthorne aphid. 7 June 1964, a few on *Amelanchier canadensis* on mainland near Plummers Island (Vogt, coll.; Smith, det.).

Prociphilus fraxinifolii (Riley), leaf-curl ash aphid. 1 June 1964 in curled leaves of *Fraxonis* sp. (Vogt, coll.; Smith, det.).

Prociphilus tessellatus (Fitch), woolly alder aphid. 23 October 1913, "woolly plant louse feeding at cracks in the bark of soft maple"; Patch wrote the determination as "*Pemphigus tessellatus (acerifolii)*." On 11 June 1956 nine specimens of this aphid (Russell, det.) were taken with females of the wasp *Xylocelia virginiana* Rohwer or were found in the nests of the wasps (Krombein 1958: 22). 17 July 1961, an alate in flight (Spangler, coll.; Tissot, det.).

Pterocomma bicolor (Oestlund), reddish brown willow bark aphid. 12 October 1913 on *Salix nigra*.

Pterocomma flocculosa (Weed), flocculent willow aphid. 1914 (no exact date given) "somewhat bluish woolly" on *Salix nigra*.

Pterocomma smithiae (Monell), willow grove aphid or black willow aphid. 5 October 1913, 28 June and 13 September 1914 on *Salix nigra*.

Rhopalosiphum rhois (Monell), Monell's sumac aphid. 7 June 1964 on *Rhus typhina* on mainland near Plummers Island (Vogt, coll.; Leonard, det.).

Smynthuroides betae (Westwood) (formerly *Trifidaphis radiculicola* (Essig)). 1 May 1914 in an ant nest under a stone on lower part of stem of *Dentaria laciniata*.

?*Stegophylla quercicola* Baker. 30 May 1964, 6 apterae on leaf of *Quercus alba* on mainland near Plummers Island (Vogt, coll.; Tissot, det.). 19 July 1964, a partly grown larva of the chrysopid, *Chrysopa 4-punctata* Burmeister (O. S. Flint, det. with query), in the remains of a colony of this aphid in the curled dead edge of a leaf of *Quercus rubra* (Vogt, coll.; Smith, det.); also one live male of the rare anthocorid bug, *Anthocoris confusus* Reuter (Jon L. Herring, det.), in an old colony with very few aphids, also in the curled edge of a red oak leaf.

Therioaphis sp. On 3 July 1959 a nest of the wasp *Stigmus* (S.) *americanus* Packard was found which contained a number of paralyzed, tightly packed, yellowish-green nymphs and adult aphids (Russell, det.; Krombein 1961: 65).

LIST OF FOOD PLANTS

Acer negundo, boxelder
Periphyllus negundinis
Acer saccharinum, silver maple
Drepanaphis acerifolii.
Drepanaphis parvus
Drepanaphis, undescribed species near *parvus*
Prociphilus tessellatus
Acer sp., maple
 ? *Drepanaphis acerifolii*

? *Drepanaphis parvus*
Amelanchier canadensis, service-berry
Prociphilus corrugatus
Amelanchier sp., shadbush
Eriosoma americanum
Apocynum cannabinum, dogbane
Macrosiphum euphorbiae
Cephalanthus occidentalis, button-bush

- Aphis cephalanthi*
Cryptotaenia canadensis, honewort
Aphis heraelella
Dentaria laciniata, toothwort
Smynthuroides betae
Desmodium sp., beggar's ticks
Microparsus variabilis
Echinochloa crusgalli, barnyard grass
Hysteroneura setariae
Eupatorium (ageratoides) rugosum, white snakeroot
Macrosiphoniella eupatorii
Fagus grandifolia, American beech
Phyllaphis sp.
Fraxinus sp., ash
Prociphilus fraxinifolii
Hamamelis virginiana, witch hazel
Hormaphis hamamelidis
Impatiens biflora, spotted touch-me-not
Catomergus fulvae
Macrosiphum impatientis
Impatiens pallida, pale touch-me-not
Aphis impatientis
Catomergus fulvae
Macrosiphum impatientis
Juniperus virginiana, red cedar
Cinara junipivora
Liriodendron tulipifera, tuliptree
Macrosiphum liriodendri
Monarda punctata, wild bergamot
Aphis monardae
Oenothera biennis, evening primrose
? *Aphis oenotherae*
Parthenocissus quinquefolia, Virginia creeper
Aphis folsomii
Pinus sp., pine
Cinara pergandei
Pinus virginiana, scrub pine
Cinara taedae
Essigella californica
Eulachnus, undescribed species
Polymnia canadensis, leafcup
Macrosiphum, undescribed species
Polymnia uvedalia, bearsfoot
Macrosiphum sp.
Populus deltoides, cottonwood
Chaitophorus populicola
Pemphigus populitransversus
Pemphigus sp.
Populus grandidentata, big-toothed poplar
Chaitophorus populicola
Ptelea trifoliata, hoptree
Myzus persicae
Quercus alba, white oak
Myzocallis bella
Myzocallis punctata
Myzocallis walshii
? *Stegophylla quercicola*
Quercus rubra, red oak
Longistigma caryae
Myzocallis bella
Myzocallis discolor
Myzocallis walshii
? *Stegophylla quercicola*
Quercus sp., oak
Myzocallis bella
Rhus typhina, staghorn sumac
Rhopalosiphum rhois
Rudbeckia laciniata, goldenglow
? *Dactynotus rudbeckiae*
Rumex crispus, curled dock
Aphis rumicis
Salix nigra, black willow
Chaitophorus viminalis
Pterocomma bicolor
Pterocomma flocculosa
Pterocomma smithiae
Solidago sp., goldenrod
? *Dactynotus ambrosiae*
Macrosiphum, undescribed species
Ulmus sp., elm
Colopha ulmicola
Ulmus americana, American elm
Colopha sp.
Colopha ulmicola
Eriosoma americanum

| | |
|--|--|
| <i>Vaccinium</i> sp., blueberry | <i>Anuraphis viburniphila</i> |
| <i>Masonaphis</i> (<i>Eriocobium</i>) <i>peperi</i> | <i>Viburnum dentatum</i> , arrowwood viburnum |
| <i>Verbesina</i> sp., crownbeard | <i>Anuraphis viburniphila</i> |
| <i>Dactynotus ruralis</i> | <i>Viburnum prunifolium</i> , blackhaw |
| <i>Verbesina</i> (<i>Actinomeris</i>) <i>alternifolia</i> , wingstem | <i>Aphis illinoisensis</i> |
| <i>Dactynotus ruralis</i> | <i>Vitis rotundifolia</i> , muscadine grape |
| <i>Verbesina occidentalis</i> | <i>Aphis illinoisensis</i> |
| <i>Dactynotus ruralis</i> | <i>Vitis</i> sp., grape |
| <i>Viburnum acerifolium</i> , mapleleaf | <i>Aphis illinoisensis</i> |
| viburnum | <i>Vitis vulpina</i> , winter grape |
| | <i>Aphis illinoisensis</i> |

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NEW TARDIGRADA FROM WESTERN NORTH
AMERICA: II, *ECHINISCUS*

BY ROBERT O. SCHUSTER AND ALBERT A. GRIGARICK
University of California, Davis

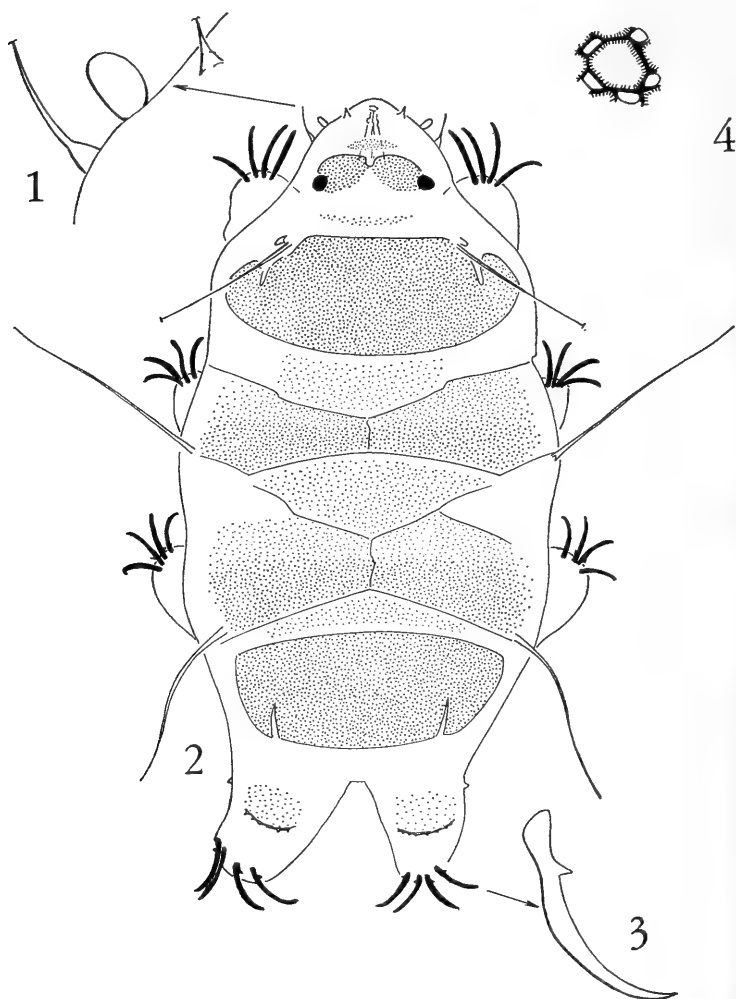
This large, distinctive species of *Echiniscus* was collected in the Riverside Mountains of southern California. It is the only undescribed species of *Echiniscus*, outside of the *arctomys* group, thus far found in California.

***Echiniscus becki*, new species**

Holotype: Length excluding legs IV 400μ ; width 170μ . Eye spots present, dark red. Cuticle of dorsal plates consisting of solid polygons tenuously interconnected, each polygon with 4, 5 or 6 bordering pores (Fig. 4); anterior halves of 1st and 2nd plate pairs, and anterior half of 2nd intersegmental plate lacking pores, the polygons not interconnected. Leg plates very faint, most obvious on legs IV. Head plate essentially divided into 2 distinct halves, transverse anterior and posterior platelets extremely faint. Intersegmental plates not transversely divided although cuticular pattern of the 2nd differs between anterior and posterior. Internal and external buccal cirri appear distally bifurcate (Fig. 1). Spine A expanded at tip. Spines C (115μ), and D (100μ) smooth, acuminate. End plate without lateral spine or spicule. Dentate collars of legs IV with 8 and 14 teeth. Legs I and IV with basal papillae. Internal claws of legs I-III simple, leg IV with apically directed spur (Fig. 3).

The holotype and 53 paratypes are from the Mountaineer Mine, Riverside Mountains, south of Vidal Junction, Riverside County, California, 25 January 1965, A. J. Beck and R. O. Schuster. The specimens were recovered by Baermann funnel extraction of sparsely occurring mosses and lichen from crevices in rocks. The type series is deposited in the Department of Entomology, Davis, except for four paratypes sent to Dr. Ramazzotti, Milano, Italy.

The shortest individual is 290μ , the longest 420μ , with most of the specimens in the series between 350μ and 380μ . The internal buccal cirrus and papilla are about 6μ or 7μ , and the external cirrus 17μ . The buccal cirri and spine A appear to be bifurcate, or perhaps ending in a small disc. A median longitudinal stripe and 2 transverse stripes



FIGS. 1-4. *Echiniscus becki*, new species, holotype. 1. Detail of buccal cirri and papilla, 2. Dorsal aspect, 3. External claw of leg IV, 4. Cuticular polygon and bordering pores.

are present on the scapular plate, barely visible with phase contrast when out of phase.

The solid appearance of the cuticular polygons is not typical of the species group *blumi-canadensis*. In the *trisetosus* group the space between pores is not defined as regular polygons. Dr. Ramazzotti has

suggested that for "practical purposes" this species might be placed with the *trisetosus* group although the grouping is an artificial one. It does not key to any species in Ramazzotti (1962) or in the revised key to *Echiniscus* (Ramazzotti, in press).

This species is named for Dr. Albert J. Beck in appreciation of his conducted tour of old mines during which the collection was made.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NEW SPECIES OF CUCKOO WASPS BRED FROM
TWIGS IN WESTERN NORTH AMERICA
(HYMENOPTERA: CHRYSIDIDAE)

BY R. M. BOHART

Department of Entomology, University of California, Davis

The following three species of Chrysididae are described to facilitate studies on twig-nesting Hymenoptera. Repositories for type material are: University of California at Davis (UCD), at Berkeley (CIS), at Riverside (UCR); California Dept. of Agriculture (CSDA); U. S. National Museum (USNM); collection of G. R. Ferguson (Ferguson Coll.); University of Idaho (U. Idaho); Washington State University (WSU); Nevada State Dept. of Agriculture (NSDA); California Academy of Sciences (CAS); collection of J. Schuh (Schuh Coll.).

Trichrysis deversor Bohart, new species

Male (holotype): Length 8.5 mm. Body greenish blue with bluish purple on scutum and on tergites medially; sternite II with large and well-separated oval spots; wings slightly dusky, venation distinct. Pubescence pale to fulvous, moderate, inconspicuous. Punctuation moderately coarse, mostly one size, scapal basin fine cross crinkled. Head broader than long, least interocular distance two-fifths head breadth; pedicel and flagellomeres I-IV with length relationships measured in mid-ocellus diameters as follows: 1.5, 2.0, 1.8, 1.5, 1.4, flagellomere I about twice as long as broad; subantennal distance and malar space 1.2 and 1.5 mid-ocellus diameters; frontal carina strong, wavy, with two pairs of well developed posterior branches; postscutellum narrowly conical, as long dorsally as scutellum; tergite III with lateral teeth weakly and median tooth strongly, acutely projecting, median subapical carina depressed at pit row.

Female (paratypes): About as in male. Color bluish green to deep blue.

Holotype male, Davis, California, 6 June 1951 (R. M. Bohart, UCD). Paratypes, CALIFORNIA: 10 males, 13 females, near Bridgeport (R. Bohart, UCD); Samuel Springs, NAPA COUNTY (R. Bohart, UCD); Fort

Seward (UCD); Tracy (P. Hurd, CIS); Bullard's Bar, YUBA COUNTY (CSDA); Oakhurst (E. Linsley, CIS); College City, reared from *Trypoxylon* twig nest (F. Parker, UCD); Fairplay, EL DORADO COUNTY (V. Potts, UCD); Illinois Valley, DEL NORTE COUNTY (T. R. Haig, UCD); Oxalis (A. Telford, UCD); Wood Lake, TULARE COUNTY (N. Frazier, CIS); Tanbark Flat, LOS ANGELES COUNTY (A. McClay, UCD); Mt. Diablo, CONTRA COSTA COUNTY, reared from *Sceliphron* nests (J. MacSwain, CIS, UCD, USNM); Riverside (A. Melander, E. Schlinger, UCR); Figuefoa Mt., SANTA BARBARA COUNTY (P. Marsh, UCD); SAN BERNARDINO COUNTY (N. Hardman, UCD); Miramar (UCD); NEVADA: 2 females, Ruby (J. Downey, UCD); Baker (F. Parker, UCD); OREGON: 3 males, 6 females, Corvallis (K. Gray, J. Schuh, Ferguson Coll., UCD, USNM); Gold Hill (C. Biederman, UCD); near Oakridge (J. Schuh, E. Hansen, Schuh Coll.); Scio (Ferguson Coll.); IDAHO: 1 male, 2 females, ADAMS COUNTY (W. Barr, U. Idaho); Lewiston (G. Ferguson, Ferguson Coll.); IDAHO COUNTY (W. Barr, U. Idaho); WASHINGTON: 1 female, Walla Walla (V. Argo, WSU); UTAH: 1 female, Hatton (G. Bohart, UCD).

Although closely related to *Trichrysis tridens* Lepeletier, *deversor* averages a little smaller, the postscutellum projects a little more slenderly, the median tooth of tergite III is stronger in comparison with the lateral ones, the posterior branchlets of the frontal carina are stronger, and the median carina of tergite III is distinctly depressed at the pit row in profile. The last characteristic separates it also from *mucronata* Brullé which occurs in Arizona and Mexico. Furthermore, *mucronata* is customarily more distinctly banded with purple on the tergites.

Chrysis barri Bohart, new species

Male (holotype): Length 5.5 mm. Body greenish to blue (purple in some paratypes); wings water clear, wing microsetae inconspicuous and pale. Pubescence mostly 1.5 ocellus diameters long, moderately thick on outer one-third of scapal basin. Punctuation moderate, slightly spaced and with smooth interspaces; scapal basin cross-striate in middle one-third, irregularly striate and punctate in lateral one-third. Head broader than long, least interocular distance slightly more than one-half width of head (10:19); pedicel and flagellomeres I to IV with length relationship measured in mid-ocellus diameters as follows: 1.9, 1.5, 1.2, 2.4, 2.1, flagellomere I about 1.5 times as long as broad; subantennal distance and malar space 1.2 and 2.1 mid-ocellus diameters respectively; ocellular distance 2.0 ocellus diameters, interocellar distance 3.2 diameters; frontal carina moderately distinct, downcurved sublaterally; ocelli not sunken nor lidded; tergite III with pits rather large and deep toward center which is a sharp and hardly depressed ridge, posterior edge thin, four teeth long, slender and sharp; median emargination semi-oval, as deep as broad, submedian one nearly as

deep as broad; lateral margin of tergite III nearly straight before strongly downturned apex.

Female (paratypes): About as in male. Color deep blue to purple, wings faintly smoky with brown microsetae. Head less broad, least interocular distance more than one-half head breadth (10:19); malar space about 2.2 mid-ocellus diameters; flagellomere I about 2.6 times as long as broad and nearly as long as II and III together; teeth of tergite III a little shorter, emarginations a little shallower; median length of tergite I a little more than one-half as great as breadth.

Holotype male, 10 mi. S Wendover, Nevada, 19 May 1962, on *Stanleya pinnata* (G. E. Bohart, UCD). Paratypes, 1 female, same data as holotype; 2 males, Mountain Home, Idaho, 29 May 1958 (W. F. Barr, U. Idaho, UCD); 2 females, 16 mi. NW Gerlach, Nevada, 18 August 1960 (F. D. Parker, NSDA, UCD); 2 females, Nixon, Nevada, reared from twig nest of eumenid (F. D. Parker, UCD, USNM); 1 male, Little Lake, Inyo County, California, 3 September 1956 (R. M. Bohart, UCD).

In the male the clear wings with pale microsetae together with the antennal formula and spiniform teeth of tergite III are characteristic. The teeth are prominent in the female, also, but to a lesser degree. The female resembles *derivata* superficially but the teeth are longer, the lateral margin of tergite III is downturned distally, the interocular distance is equal to about 3.0, rather than 2.1, ocellus diameters, tergite I is much shorter, and the head is considerably narrower at the malar space than at the widest point. Differences from *irwini* are given under that species.

***Chrysis irwini* Bohart, new species**

Male (holotype): Length 5.0 mm. Body greenish blue, wings very faintly and rather uniformly smoky. Pubescence mostly not over 1.5 ocellus diameters long, rather scanty on lower face. Punctuation moderate; scapal basin almost completely punctate, substrate medially. Head broad, least interocular distance more than one-half width of head (10:19); pedicel and flagellomeres I to IV with length relationships measured in mid-ocellus diameters as follows: 2.0, 2.1, 1.2, 2.0, 1.8, flagellomere I about 1.8 times as long as broad; subantennal distance and malar space 1.0 and 1.9 midocellus diameters respectively; ocellocular distance 2.0 ocellus diameters and interocular distance about 2.5; frontal carina rather weak, downcurved sublaterally; ocelli not sunken nor lidged; tergite III with moderate pit row divided medially by a sharp carina continued from above; posterior edge thin, all four teeth rather sharply pointed, median emargination 0.6 times as deep as broad, submedian one 0.4 times; lateral margin of tergite III moderately concave.

Female (paratypes): Generally similar to male. Malar space 2.2 to 2.5 mid-ocellus diameters; flagellomere I about 2.5 times as long as broad, I to III with length relationships measured in mid-ocellus diame-

ters of 2.8, 2.2, 1.9; median length of tergite I a little more than one-half as great as breadth; tergite III slightly depressed subbasally and a little swollen before pit row.

Holotype male, Davis, California, 17 May 1963 (M. E. Irwin, UCD). Paratypes, 13 males and 15 females from California, May to November, as follows: Davis (M. E. Irwin, P. Paige, H. Court, E. Schlinger, UCD, USNM, U. Idaho, AMNH, KU); Boca reared from twig nest of eumenid (F. D. Parker, UCD); Meyers, El Dorado County (R. Bohart, UCD); Strawberry, Tuolumne County (T. Gantenbein, UCD); Live Oak, Sutter County (P. Marsh, UCD); Knights Landing (M. Irwin, UCD); Winters (C. G. Moore, UCD); Danville (F. X. Williams, CAS); San Antonio Valley, Santa Clara County (P. D. Hurd, CIS); Borrego (E. Schlinger, UCR). Also, 1 female paratype, Medford, Oregon, 27 September 1956 (G. Fitch, UCD).

This small species is similar to *barri* in having a fairly long male flagellomere I. In addition to its distinctive genitalia the male of *irwini* differs by the duskier wings, weaker frontal carina, more evenly concave lateral margin of tergite III, and presence of a "pre-pit-row" carina on tergite III. Both sexes have shorter teeth on tergite III and a more evenly punctate scapal basin. Also, the female has a definite bulge before the pit row and the head is proportionately broader.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF LACEBUG FROM CHINA
(HEMIPTERA: TINGIDAE)

BY CARL J. DRAKE¹

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In 1911, Distant erected the monotypic genus *Hegesidemus* (type-species, *H. elianus* Distant) from Ceylon. Years later, Drake (1948) transferred *Teleonemia*? *elegantula* Distant (1909) (= *Compseuta elegantula* Bergroth, 1921) from Borneo to *Hegesidemus*. Since 1948, *H. otiosus* Drake (1953), from India, and *H. pauliani* Drake (1957), from Reunion, have been described. The present paper characterizes a fifth species of *Hegesidemus* as new from China. For full references to the genus and its members see Drake and Ruhoff (1965).

The illustration for the present paper was made by Mrs. E. H. Froeschner.

Hegesidemus habrus, new species

Fig. 1

Description (male holotype): Moderately large, rather broad, testaceous with pronotal disc and head blackish fuscous; collar, paranota, apex of backward projection of pronotum, and carinae testaceous; cephalic spines testaceous, the anterior three greatly reduced or wanting. Elytra mostly dark testaceous with fuscous areas as depicted in the illustration. Body beneath reddish brown to dark fuscous; sternum black, dull; rostral sulcus with buccal and sternal laminae testaceous. Antenna testaceous with apical half of fourth segment blackish fuscous. Length 3.25 mm, width (elytra) 1.40 mm.

Head short, convex above, smooth, with basal pair of spines long, slender and appressed; three frontal spines very short and testaceous or obsolete; antennal tubercles short, bluntly rounded in front, concave on inner side, bucculae areolate, closed in front. Labium long, reddish brown, the tip darkened, barely touching metasternum in repose. Antennae long, slender, inconspicuously pubescent, measurements: seg-

¹The author passed away shortly after submission of this paper.

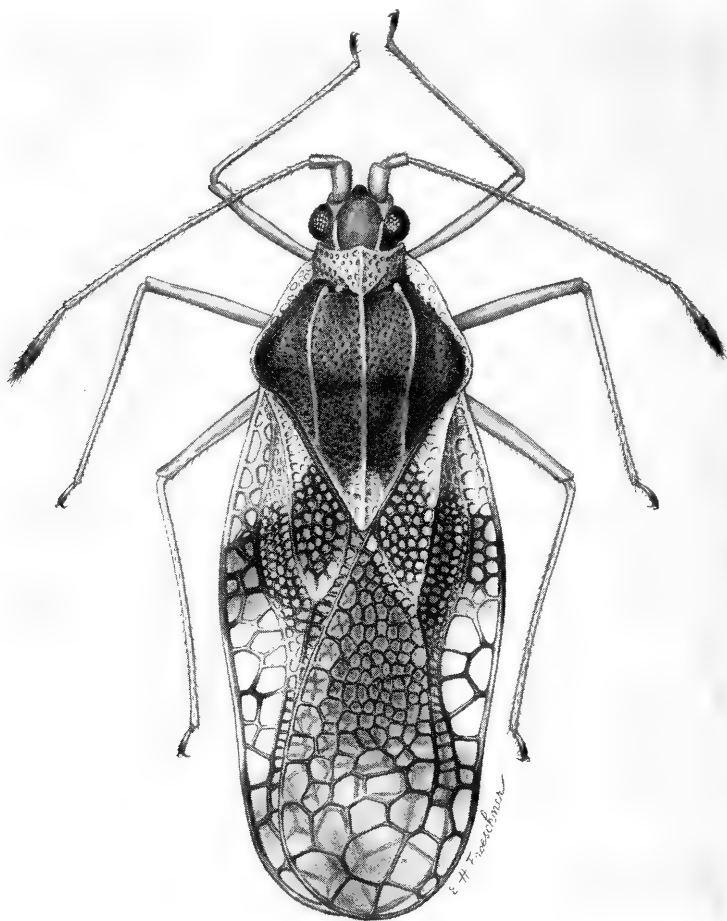


FIG. 1. *Hegesidemus habrus* Drake, holotype male.

ment I, 14; II, 9; III, 56; IV, 18. Legs long, slender, tarsi becoming fuscous apically.

Pronotum moderately convex, distinctly punctate, tricarinate; all carinae about equally raised, not clearly areolate, the lateral pair slightly concave on fore part of pronotal disc and terminating in front at calli; hood moderately large, tectiform, tapered posteriorly, extending backwards between calli; paranota narrow, slowly widened anteriorly, feebly reflexed, uniseriate behind middle, then wider and biseriate in front. Elytra wider and longer than abdomen, widest at crossband; su-

tural areas apices overlapping in repose; costal area moderately wide, widest just posterior to discoidal area, there with areolets larger and becoming uniseriate in apical fourth; subcostal area wide, with four rows of areolets along side of apical two-thirds of discoidal area, then much narrowed and uniseriate in distal third; discoidal area large, not extending posteriorly as far as middle of elytron, acutely angulate at base and apex, five areolets wide opposite posterior projection of pronotum; sutural area very large, areolets distinctly larger in apical two-fifths. Hind wings whitish, apices surpassing tip of abdomen.

Holotype ♂ and *allotype* ♀: Both macropterous, Suisapa, Lichnan District, China, 28 July 1948, J. L. Gressitt, in California Academy of Sciences. *Paratypes*: 7 specimens, all bearing identical labels as the holotype and allotype.

Two other members of the genus each possesses a premedian crossband and differ from *H. habrus* as follows: 1) *H. pauliani* has a smaller pronotal hood, paranotum very narrow and not widened in front, and the costal area entirely biseriate; 2) *H. setiosus* is larger with costal area wider and entirely triseriate and the discoidal extends backward beyond middle of elytron. In one specimen of the latter species, the elytra are without a crossband.

Etymology: The specific name is derived from Greek and means "delicate."

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

STUDIES ON NORTH AMERICAN BEES OF THE
GENUS *HYLAEUS* 2. DESCRIPTION OF A NEW
SUBGENUS AND SPECIES
(HYMENOPTERA: COLLETIDAE)

BY ROY R. SNELLING

Los Angeles County Museum, Los Angeles, California

The following new subgenus and species are described at this time in order that the names might be available for a forthcoming paper on the subgenera of *Hylaeus* occurring in the Nearctic Region. For the loan of the material recorded below I am indebted to the following individuals: H. E. Evans, Museum of Comparative Zoology (MCZ); P. D. Hurd, Jr., California Insect Survey, University of California, Berkeley (CIS); K. V. Krombein, United States National Museum (USNM); A. T. McClay, University of California at Davis (UCD); C. D. Michener, University of Kansas (UK); J. G. Rozen, Jr., American Museum of Natural History (AMNH); F. G. Werner, University of Arizona (UA).

Hylaeus, Subgenus **Prosopella** Snelling, new subgenus

Although superficially similar to *Paraprosopis* both sexes are very different from that and all other Nearctic subgenera. From *Paraprosopis* the males differ in the entire and bare, rather than bifid and hairy, ninth ventrite. The ninth ventrite is unique among North American *Hylaeus* in that the apical process is sharply bent downward at an angle about 45°. The shape of the eighth ventrite strongly suggests that of the Neotropical subgenus *Hylaeopsis*, which *Prosopella* further resembles in the extremely coarse punctures of the head and thorax. The female most closely resembles those of *Paraprosopis* but differs by the very coarse punctation and the transversely rugose basal area of the propodeum.

Head slightly longer than broad in both sexes; male first flagellar segment broader than long, shorter than pedicel, about half as long as second flagellar segment; female facial foveae hardly separated from eye margins above; supraclypeal area of male a little more than half

as long as clypeus (area of supraclypeal mark less than half as long as clypeus); thorax very coarsely punctate; lateral and oblique propodeal carinae absent; basal area of female propodeum with rugae largely transverse; ventrite VII of male deeply emarginate medially; ventrite VIII with apical lobes small, neither pectinate nor laterally emarginate, with a few hairs apico-laterally; ventrite IX with spiculum subequal to length of disc, apical process longer, its apex broadened, apical process reflexed downward at angle of about 45°, apex bare; gonoforceps slightly broadened basally, blunt apically, with a few long simple hairs apically.

Etymology: *Prosopella* diminutive of *Prosopis*, a subgenus of *Hylaeus*, gender feminine.

Type species of subgenus: *Hylaeus (Prosopella) hurdi* Snelling, new species.

***Hylaeus (Prosopella) hurdi* Snelling, new species**

Fig. 1

Superficially the female resembles *H. wootoni* (Cockerell), but it is easily separated from this, and all other Nearctic *Hylaeus* by the combination of maculate clypeus, extremely coarse thoracic punctures and transversely rugulose basal propodeal area. The male may be recognized among the superficially similar small species by its distinctly and coarsely punctate clypeus, coarsely punctate thorax, transversely rugulose basal propodeal area and details of ventrites VIII and IX.

Male (composite description): Integument black, except for dull yellow maculae as follows: mandibles, except ferruginous apices; labrum; clypeus; supraclypeal spot; paraocular areas, extending narrowly along inner orbits to level a little below midpoint between antennal sockets and median ocellus (Fig. 1A); medially interrupted stripe on pronotal collar; pronotal tubercles largely; spot on tegulae; small to minute apical spot on all femora; fore tibiae, except irregular brownish blotch on posterior surface; basal one-fourth and small apical spot on middle tibiae; basal one-third and small apical spot on hind tibiae; all basitarsi. All medio- and distitarsi ferruginous yellow. Tarsal claws ferruginous apically, yellow basally as are tibial spurs. Wings clear hyaline, veins and stigma brownish. Pubescence whitish, sparse, except on underside of head where it is relatively long and abundant.

Head: UFD $0.79 \times$ FL; LFD $0.58 \times$ UFD; OCD $1.13 \times$ TFD; clypeus slightly wider basally than distance between laterobasal angle and eye margin; distance between antennal sockets almost twice a socket diameter, the latter about equal to distance from socket to eye margin; clypeus and supraclypeal area dull, densely tessellate, with large, conspicuous punctures separated by about a puncture diameter; maculate lateral areas a little shinier, punctation as on clypeus; immaculate areas dull, densely, coarsely punctate; genae dull, densely punctate, punctures smaller than those of vertex, more obscure. First flagellar

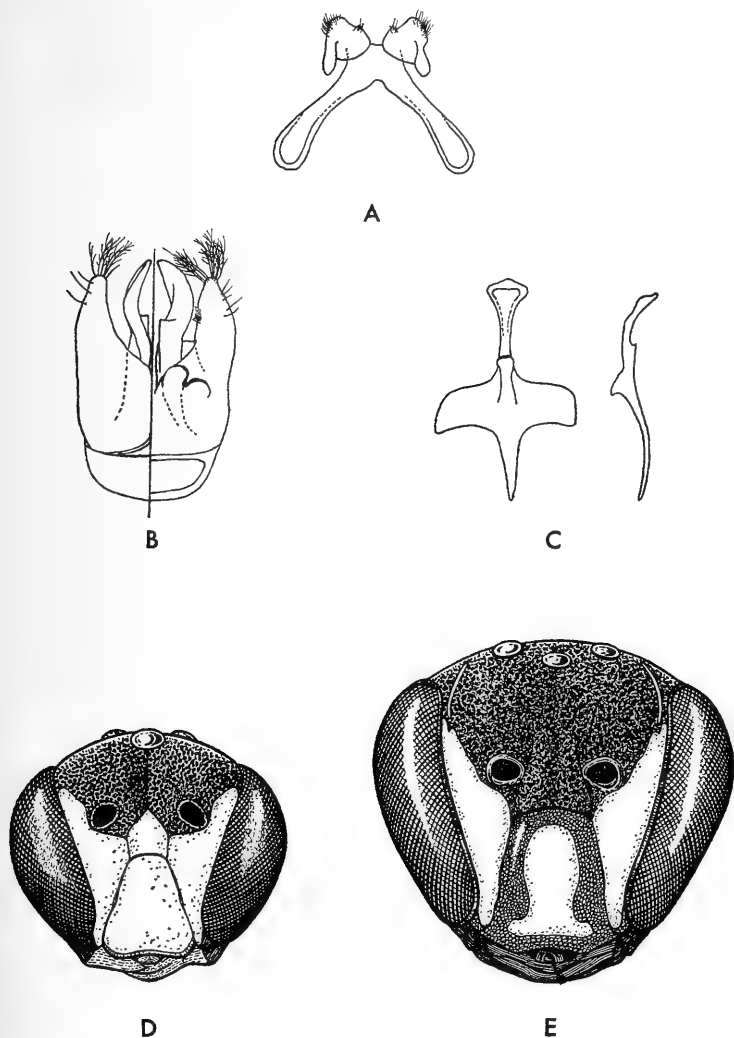


FIG. 1. *Hylaeus (Prosopella) hurdi*, new species. A, ventrite viii of male; B, genitalia of male, left half dorsal aspect, right half ventral aspect; C, ventrite ix of male, dorsal and lateral aspects; D, face, male; E, face, female. C and D by Evie Templeton, Los Angeles County Museum Exhibitions Staff.

segment subequal to pedicel, minimum length a little more than half its breadth, maximum length almost equal to minimum length of second.

Thorax: Outer margin of fore coxa slightly convex to straight; mesopleural punctures very coarse, close, interstices densely tessellate, slightly shining; mesoscutal punctures coarser, subcontiguous, interstices less shining than those of mesopleurae; mesoscutellar punctures equal to those of mesoscutum, more separated, interstices shinier; metanotum dull, densely tessellate, with coarse, close, deep punctures; basal area of propodeum rugulose, the rugae variable, but usually distinctly transverse; remainder of propodeum, including posterior face, densely, distinctly punctate; oblique carina absent, lateral carina obliterated above lower one-fifth.

Abdomen: Tergite I shining, punctures fine, separated by a puncture diameter or a little more; tergite II duller, more distinctly tessellate, with finer, more obscure punctures, mostly separated by more than a puncture diameter; tergites III–VI similar to II, with piliferous punctures a little larger, but more obscure than those of II; ventrites VIII, IX and genitalia as in Fig. 1 C–E.

Measurements: Body length (front of vertex to apex of second tergite), 3.2 to 4.0 mm; forewing length, 2.9 to 3.6 mm.

Female: Integument black, except dull yellow as follows: elongate median mark on clypeus; irregular supraclypeal spot (absent in some paratypes); paraocular area, extending along inner eye margin to level midway between antennal sockets and median ocellus (Fig. 1B); medially interrupted pronotal stripe; pronotal tubercles largely; spot on tegulae; basal one-third of fore and hind tibiae; basal one-fourth of mid tibiae; tibial spurs. Wings as in male. Pubescence light, sparse.

Head: UFD $0.81 \times \text{FL}$; LFD $0.65 \times \text{UFD}$; OCD $0.92 \times \text{TFD}$; clypeus a little wider basally than distance from latero-basal angle to inner eye margin; distance between antennal sockets slightly greater than a socket diameter, the latter equal to distance between sockets and eye margin; clypeus and maculate areas dull, very densely tessellate, with scattered shallow large punctures; immaculate areas a little shinier, subrugulose from coarse punctures; genae slightly shining, with punctures a little finer than those of frons, more separated; facial foveae above hardly separated from eyes.

Thorax: Mesopleurae slightly shining, punctures very coarse, subcontiguous to about one-half a puncture diameter apart; mesoscutal punctures coarser, subcontiguous; mesoscutellar punctures equal to those of mesoscutum, slightly more separated; metanotal punctures equal to those of mesoscutum, interstices dull, very densely tessellate; basal propodeal area distinctly transversely rugulose in most specimens, the rugulae extending onto the vertical face; remainder of propodeum distinctly, closely punctate; lateral carina absent above lower one-fourth or less; oblique carina absent.

Abdomen: Tergite I distinctly tessellate, slightly shining, with fine

punctures separated by about a puncture diameter; tergite II similar, but punctures much finer; remaining tergites similar to II.

Measurements: Body length (front of vertex to apex of second tergite), 3.5 to 4.8 mm; forewing, length, 3.2 to 4.5 mm.

Holotype male and allotype female (Los Angeles County Museum), Southwest Research Station, Chiricahua Mts., Arizona, 3 September 1959 (G. I. Stage). Paratypes. ARIZONA: 2 ♀♀, same data as allotype (LACM); 1 ♂, Rustler's Park, Chiricahua Mts., 13 August 1958 (P. D. Hurd; CIS); 1 ♀, same locality as allotype, 16 July 1956 (C. and M. Cazier; AMNH), on *Melilotus alba*; 1 ♀, Portal, 2 mi. NE, 1 August 1959 (M. Statham; AMNH), on *Baccharis*; 3 ♀♀. Globe, July 193? (F. H. Parker; MCZ); 1 ♀, Portal, 5 mi. W, 13 August 1958 (C. G. Moore; UCD); 3 ♂♂, 2 ♀♀, Santa Catalina Mts., 14 July 1961 (M. L. Noller), on *Ceanothus*; 2 ♀♀, same locality, 18 July 1955 (G. D. Butler and F. G. Werner), on *C. greggii*; 3 ♀♀, same locality, 14 August 1954 (G. Bohart and G. Butler); 1 ♀, same locality, 25 August 1954 (G. D. Butler); 1 ♂, west slope Patagonia Mts., 9 August 1956 (F. G. Werner and G. D. Butler); 1 ♂, 4 ♀♀, Ramsey Canyon, Huachuca Mts., 12 July 1955 (G. D. Butler and F. G. Werner), on *M. alba*; 11 ♂♂, Graham Mts., 8 July 1955 (G. D. Butler and F. G. Werner), on *Ceanothus*; 1 ♂, 9 ♀♀, same locality, 9 August 1955 (Butler and Noon; all UA), 1 ♀ on *Ceanothus*, ♂ on *Verbesina encelioides*; 1 ♂, Flagstaff, 7-9 July 1959 (K. V. Krombein; USNM); 2 ♀♀, Santa Rita Mts., VII (F. H. Snow); 2 ♂♂, Chiricahua Mts., 21 July 1950 (J. G. Rozen); 1 ♂, same locality, 20 July 1950 (J. Arnold); 15 ♂♂, 2 ♀♀, Santa Catalina Mts., 14 July 1950 (H. O. Wright); 16 ♂♂, 4 ♀♀, same data, except (R. H. Beamer); 17 ♂♂, 12 ♀♀, same data, except (L. D. Beamer); 10 ♂♂, 5 ♀♀, same locality, 15 July 1950 (L. D. Beamer); 3 ♂♂, 2 ♀♀, same locality, 16 July 1950 (L. D. Beamer); 1 ♂, 1 ♀, same data, except (R. H. Beamer; all UK). MEXICO: 1 ♀, approx. 18 mi. S Creel, CHIHUAHUA, no date (R. M. Straw, No. 1910; LACM), on *Penstemon campanulatus*. Paratypes in the collections of the University of California at Davis and Berkeley, University of Arizona, University of Kansas, the American Museum of Natural History, United States National Museum, Museum of Comparative Zoology, the Los Angeles County Museum, and Mr. G. I. Stage.

I take great pleasure in naming this species for Dr. Paul D. Hurd, Jr., in grateful recognition of his continued assistance and encouragement during the course of this study.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW CRAWFISH OF THE GENUS *ORCONECTES*
FROM THE HEADWATERS OF THE WHITE
RIVER IN ARKANSAS
(DECAPODA, ASTACIDAE)

BY J. F. FITZPATRICK, JR.

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In the summer of 1961 Dr. Perry C. Holt gave me a small collection of crawfishes which he had collected from the headwaters of the White River in Arkansas. They proved to be an undescribed species of the genus *Orconectes*. In January, 1965, I collected in Madison County, Arkansas and was able to add two more localities for this new species. All of the localities are in the headwaters of the White River in Madison County, Arkansas.

I wish to express my thanks to Dr. Holt, to Dr. Horton H. Hobbs, Jr., who confirmed my diagnosis and critically read this manuscript, and to my wife, Sarah E. Fitzpatrick, who is my usual helpmate in field collections.

This new species is named in honor of Dr. Austin B. Williams in recognition of his contributions to the knowledge of Ozark-Ouachita crawfishes.

***Orconectes williamsi*, new species**

Diagnosis: Pigmented; eyes normal. Rostrum with small marginal spines or tubercles, concave above, median carina absent, margins slightly converging, slightly inflated at base but not otherwise thickened; areola length 32-35 percent of entire carapace length, 4.8-5.2 times longer than broad, with 4-5 punctations across narrowest part. Postorbital ridges strong, terminating cephalically in strong divergent corneous tubercles or spines; carapace without cervical spine or tubercle. First pleopod of first form male reaching cephalic margin of third pereopod coxopodite when abdomen is flexed; no strong cephalic shoulder present; central projection longer than mesial process with tip curving caudodistally over mesial process; tips divergent, mesial process straight and

setiform, tapering from base to tip. Annulus ventralis immovable, subrhomboid in outline, with deep transverse trough in middle third.

Holotypic male, Form I: Body subcylindrical, slightly depressed. Abdomen narrower than cephalothorax (9.0, 10.9 mm in widest parts, respectively); carapace width greater than depth in region of caudodorsal margin of cervical groove (10.9, 8.3 mm).

Areola moderately broad (5.2 times longer than wide), with 4-5 punctations across narrowest part. Cephalic section of carapace about 2.04 times as long as areola; areola length 32.8 percent of entire length of carapace.

Rostrum margins slightly converging, not distinctly thickened, expanded basally, terminating cephalad in very weak corneous spines; distinctly campanulate outline in dorsal aspect; upper surface moderately concave and bearing setiferous punctations. Acumen long, broad, extending cephalad to distal end of antennule peduncle; tip not upturned. Subrostral ridges evident in dorsal aspect for short distance at bases.

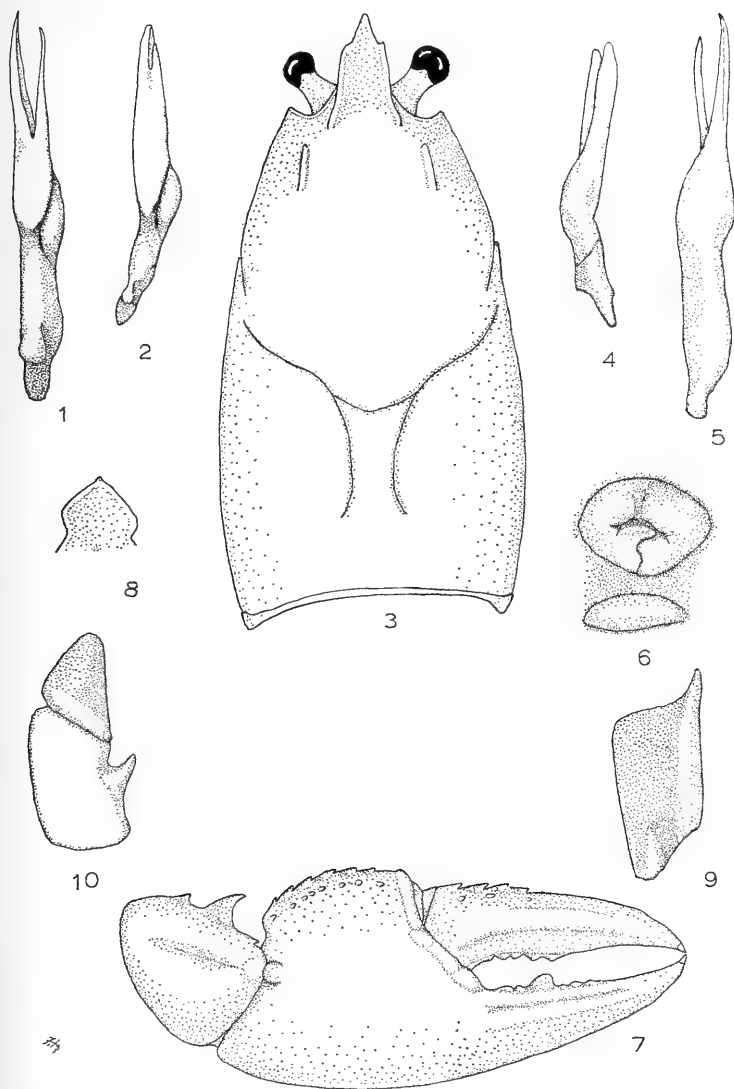
Postorbital ridges strong, grooved dorsolaterally, produced cephalad in prominent divergent tubercles. Suborbital angles acute. Branchiostegal spines acute. Cervical spines or tubercles lacking. Entire carapace studded with setiferous punctations except cephalolateral ventral portions, which bear setiferous granulations.

Abdomen longer than carapace (22.0, 20.7 mm). Cephalic section of telson with two spines in each caudolateral corner.

Epistome (Fig. 8) subrhomboidal in outline with tubercular cephalo-median projection.

Antennules of usual form with prominent spine on ventral surface of basal segment. Antennae broken, but probably reaching caudal region of abdomen. Antennal scale (Fig. 9) about 1.6 times longer than broad with lamellar portion subrectangular in outline, slightly expanding distally.

Chela (Fig. 7) somewhat depressed, palm inflated, all surfaces bearing setiferous punctations. Tubercle present on lower surface of palm at dactyl base. Palm inner margin with two irregular rows of tubercles, lower row of six, upper row of eight. Fingers gaping slightly throughout their length. Upper surface of immovable finger with broad submedian longitudinal ridge flanked by setiferous punctations; another ridge along proximal three-fourths of finger immediately mesial to aforementioned ridge. Outer margin of immovable finger with well-defined keel extending proximally one-half length of palm; opposable margin with row of two small, one large, three small (basal to distal) tubercles along basal two-thirds and crowded minute denticles along distal one-third; lower surface with submedian longitudinal ridge. Dactyl similar to immovable finger above and below; mesial margin with double row of tubercles, lower row of four, upper row of three, extending about half-way from base to tip; opposable margin with four tubercles along basal half and crowded minute denticles in distal half.



FIGS. 1-10. *Orconectes williamsi*, new species. 1. Mesial view of first pleopod of holotype. 2. Mesial view of first pleopod of morphotype. 3. Dorsal view of carapace of holotype. 4. Lateral view of first pleopod of morphotype. 5. Lateral view of first pleopod of holotype. 6. Annulus ventralis of allotype. 7. Upper surface of distal podomeres of cheliped of holotype. 8. Epistome of holotype. 9. Antennal scale of holotype. 10. Basipodite and ischiopodite of third pereopod of holotype.

Cheliped carpus longer than broad, with broad shallow longitudinal furrow above; setiferous punctations over entire surface; mesial surface with prominent, curved, acute spine, upper mesiodistal surface with smaller spine, upper proximomesial surface with small acute spine; lower submedian distal margin and lower laterodistal margin each with strong spine. Upper and lower surfaces of merus with scattered setiferous punctations; lateral surfaces generally smooth; three spines on upper distal surface; lower mesial surface with row of nine acute spines increasing in size distally, terminating in single strong acute spine; lower laterodistal margin with single acute spine and row of one spine and three tubercles proximal to aforementioned spine. Lower proximal ischiopodite surface with small rounded tubercle. Hooks on third pereopod ischiopodites only (Fig. 10); hooks simple.

First pleopod extending cephalad to cephalic margin of third pereopod when abdomen is flexed. Tip terminating in two distinct, slightly divergent parts; rami separated for moderate distance from tips (Figs. 1, 5). Central projection corneous, straight except tip curved caudadistally. Mesial process not extending so far distad as central projection, non-corneous, setiform, tapering from base to tip. Pleopods symmetrical (*sensu* Hobbs, 1962).

Morphotypic male, Form II: Differs from holotype in the following respects: margins of rostrum not quite so converging distally, terminating cephalad in small tubercle on right side, ornamentation lacking on left cephalic terminus of rostral margin but strong shoulder at base of acumen. Palm of cheliped less inflated and proportionately smaller. Hooks on ischiopodites of third pereopods much reduced. Both elements of first pleopod noncorneous, blunter, and in close approximation almost to tips; suture delimiting basal and distal portions of pleopod (Figs. 2, 4).

Allotypic female: Differs from holotype in the following respects: cheliped palm less inflated and proportionately smaller. First pleopod biramous and weakly developed. Postorbital ridges terminating cephalically in spines.

Annulus ventralis immovable, about as long as broad, prominently elevated (ventrally) above sternum. Deep transverse trough in middle third. Sinus arising in cephalomedian portion of trough, curving sharply sinistrad and gently caudad, recurving to midline, then turning caudad to wind sinously to submedian caudal margin of annulus (Fig. 6).

Measurements. As follows (in mm):

| | Holotype | Allotype | Morphotype |
|----------|----------|----------|------------|
| Carapace | | | |
| Height | 8.3 | 10.1 | 7.6 |
| Width | 10.9 | 12.5 | 8.2 |
| Length | 20.7 | 23.2 | 16.3 |
| Rostrum | | | |
| Width | 5.8 | 6.1 | 4.2 |
| Length | 3.1 | 3.1 | 2.8 |

| | | | |
|--------------------------|------|------|------|
| Areola | | | |
| Width | 6.8 | 7.5 | 5.3 |
| Length | 1.3 | 1.5 | 1.1 |
| Chela | | | |
| Palm inner length | 6.0 | 5.8 | 4.1 |
| Palm width | 7.8 | 8.1 | 4.8 |
| Hand outer margin length | 17.0 | 17.2 | 11.4 |
| Dactyl length | 9.9 | 10.8 | 6.9 |

Type-locality: White River, 2.8 miles east of Pettigrew, Madison County, Arkansas. Here the river is about four feet wide and one foot deep.

Disposition of types: The holotypic male, Form I, the allotypic female, and the morphotypic male, Form II, are in the collections of the United States National Museum (Nos. 115520, 115521, and 115522, respectively). Topoparatypes are in the collections of the Museum of Comparative Zoology, Harvard University (No. 12638; 1 ♂, 1 ♀) and of the author (1 ♂, 4 ♀, 2 ♀j). Other paratypes are in the collections of the author (2 ♂, 2 ♂, 6 ♀, 1 ♀j) and the Ohio State Museum of Natural History (1 ♂, 2 ♀).

Range: *Orconectes williamsi* is known from only three localities, all in the headwaters of the White River in Madison County, Arkansas: (1) The type-locality; (2) White River, 0.9 mi. E Pettigrew; and (3) Small stream tributary to War Eagle Creek, 8.2 mi. N junction of State Routes 16 and 23, on Rte. 23.

Variations: Only slight, insignificant variations were found in the type series. These were mostly differences in spination of the several loci at which spination can be found.

Relationships: *Orconectes williamsi* is a member of the Hylas Group of the Propinquus Section of the genus *Orconectes*. Its affinities are probably close to *O. n. nana* Williams (1952) and *O. n. macrus* Williams (1952). It differs from both in having a rostrum which is less compressed laterally, having a more oval annulus, and in lacking a strong cephalic shoulder on the first pleopod.

Associates: At the type locality *O. williamsi* was the only crawfish collected, but at both of the other localities it was collected with *O. m. meeki* (Faxon, 1898).

Remarks: *Orconectes williamsi* has a ground color which is light brown or tan and the entire body is mottled in dark brown, or sometimes black. Most of the specimens which I collected (localities 2 and 3 above) were taken from pool areas with *O. m. meeki* being found in the riffles. *O. williamsi* was found under proportionately very large stones. Stones of the same size in riffle areas yielded *O. m. meeki* of about 40–50 mm cephalothorax length, and smaller stones in the pool areas covered only juveniles of both species.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

DISCOVERY OF THE FEMALE OF THE BLACK-
THROATED ROBIN, *ERITHACUS OBSCURUS*
(BEREZOWSKY AND BIANCHI)

BY S. DILLON RIPLEY AND BEN KING

Secretary of the Smithsonian Institution and Chief Migratory Animals
Pathological Survey, APO San Francisco, California U.S.A. 96346

In July, 1965, a letter from King to Ripley asked help in identifying a small specimen of chatlike thrush, and requested that it be added to the bird collection of the U.S. National Museum. The specimen has been critically examined by the senior author, who compared it with specimens in the collections of the U.S. National Museum, the American Museum of Natural History, and the British Museum (Natural History). To the authorities of the latter two institutions we wish to express our thanks for many considerations and kindnesses.

Ripley (1958) pointed out that the female of *Erithacus obscurus* (a species which had been confused with *E. pectoratus* [David] was unknown, and that probably part of the confusion which had resulted in attempts to suppress one species by lumping with the other as a color phase or polymorphic population would be resolved by finding the unknown female of *obscurus*. This supposition has been verified with the collecting of the present specimen in a mist net by King's field team 3 February 1965, at Bung Guy, 7 km S of Chiang Saen, Chiang Rai, northern Thailand. This specimen measures: Wing 68, tail 49.5, culmen 12, tarsus 28.5 mm. These measurements are slightly smaller than those of females of *pectardens* which typically have wing measurements in the 69-73 mm range and tail measurements of 52-55 mm. While the wing measurements of male *obscurus* are roughly similar to those of *pectardens* (see Ripley, *op. cit.*, p. 3), there does seem to be a slight tendency towards a longer tail in male *pectardens*, a tendency borne out by this single female speci-

men when compared with female *pectardens*. Color of the soft parts of the female *obscurus* specimen was as follows: iris dark brown, bill blackish brown, mandible slightly paler; feet brownish blue, claws brown, mouth flesh. The condition of the ovary indicated that the specimen was not in breeding condition.

In color the differences are striking. The female *obscurus* is olive brown above, more light olive than warm brown as in *pectardens*. The upper tail coverts are russet and the tail brown as in *pectardens*.

The areas below the throat, the upper breast and the flanks are grayish buff rather than rich buff, the center of the lower breast and belly white. The vent and under tail coverts are sandy-buff, paler than in *pectardens*. The overall impression is of a soft cool-gray-brown bird, much less warmly or richly colored than *pectardens*. These muted tones match chromatically the blues and blacks of the adult male *obscurus* in contrast to the blue and orange of *pectardens*. The single specimen was taken in low rolling hills above a large marsh at 1300 feet above sea level. The predominant vegetation was bamboo mixed with stands of grass, a few shrubs and scattered trees. *Erithacus cyane* (Pallas) was noted in the vicinity.

This record adds a new species to the migratory avifauna of Thailand and extends the range of *Erithacus obscurus* (as noted by Ripley, in Peters, 1964, p. 10), known previously only from southeast Kansu and southwest Shensi, west China.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW RECORD OF *MESOCYCLOPS TENUIS* (MARSH)
WITH A DESCRIPTION OF THE MALE
(COPEPODA: CYCLOPOIDA)¹

BY EDWARD B. REED AND MARY ALICE MCQUAID

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Fort Collins, Colorado

Marsh (1910) described *Cyclops tenuis* from Arizona. No published record of the occurrence of *tenuis* in the United States has appeared in the intervening years. Dr. Harry Yeatman, University of the South, Sewanee, Tennessee, informed us by letter that he found *M. tenuis* in a plankton sample taken near Louisville, Kentucky, 9 September 1961. *M. tenuis* has been reported from Panama and the Canal Zone (Marsh 1913, Dodds 1926), El Salvador (Marsh 1931), Brazil (Kiefer 1936b), Paraguay (Lowndes 1934) and Yucatan (Wilson 1936 and Pearse and Wilson 1938). *M. tenuis* has been mentioned in several more papers, but these references are only to the collections of the just-mentioned authors. In none of these papers was the male of *tenuis* described or figured. Thus when several females and mature males were found in some plankton tows made by Dr. Walter Moore, Loyola University, New Orleans, Louisiana, and forwarded to us by Mrs. Mildred S. Wilson, Arctic Health Research Center, Anchorage, Alaska, an opportunity to add to the description of the female and place figures of the male in the literature presented itself.

Specimens have been deposited in the United States National Museum and the National Museum of Canada.

Our figures were made with a camera lucida from dissected specimens in glycerin and undistorted by cover glass pressure.

A widely recognized problem is that of assessing individual variation among the members of a species. Many factors including nutrition, temperature and water turbulence have been demonstrated to affect

¹ This study is part of a research program supported by National Science Foundation Research Grant 24954.

TABLE 1. Measurements of adult female *Mesocyclops tenuis* from Louisiana

| | N | Mean | Standard deviation | Standard error | Confidence limit t = 0.9 |
|---|----|-------------------|--------------------|------------------|-----------------------------|
| Ramus length | 23 | 75.8 ¹ | 2.55 ¹ | .53 ¹ | ± .91 ¹ |
| Ramus width | 23 | 21.8 | 1.28 | .27 | .46 |
| Length of 3rd segment, endopod, leg 4 | 22 | 55.1 | 2.36 | .50 | .86 |
| Width of 3rd segment, endopod, leg 4 | 22 | 16.0 | .99 | .21 | .36 |
| Length of inner spine, 3rd segment, endopod, leg 4 | 20 | 62.8 | 3.62 | .81 | 1.40 |
| Length of outer spine, 3rd segment, endopod, leg 4 | 21 | 27.4 | 1.35 | .30 | .51 |
| Genital segment length | 23 | 135.9 | 6.17 | 1.29 | 2.21 |
| Genital segment width | 23 | 102.2 | 4.95 | 1.03 | 1.77 |

¹ microns

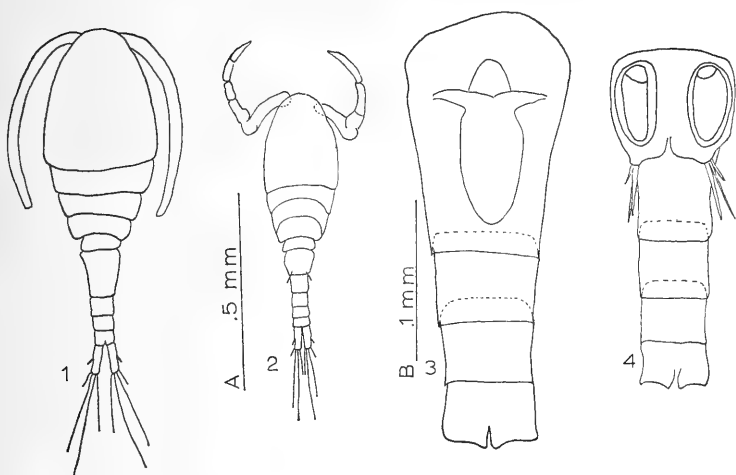
copepod morphology. These factors in conjunction with genetic variability and the fact that populations in different lakes are not freely interbreeding add to variability in morphology. A few freshwater copepodologists have expressed individual variability in terms of ranges of various measurements; however, fewer investigators have used even elementary statistical procedures to help describe variability.

We measured a series of females for those morphological characters which custom and experience have indicated as being helpful in distinguishing species. The animals to be measured were picked at random from the entire sample, the only criterion being that the individuals be adult. Table 1 summarizes our results. Ratios between body parts have been found valuable in some instances; ratios based on confidence limits are therefore included in Table 1.

Female: Total length exclusive of terminal setae about .85 mm (Fig. 1); antennules 17-segmented; ultimate and penultimate segments not bearing any hyaline membrane (Fig. 5); tips of reflexed antennules reaching at least to middle of third and sometimes to posterior border of fourth thoracic segment.

Antenna consisting of 4 segments, terminal bearing 6 setae (Fig. 6); proximal segment bearing 2 setae, longest reaching to distal end of ultimate segment; inner margins of 2nd, 3rd and 4th segments bearing short hairs, some stiff and nearly spinelike; palp of mandible bearing 2 long setae (Fig. 7); blade expanded at tip and bearing many small teeth.

Maxillule consisting of 5 segments (Fig. 8); segment 1 possessing small prominence with 2 setae; segment 2 with long spine arising from inner



FIGS. 1-4. *Mesocyclops tenuis* (Marsh), Louisiana, female: 1, dorsal outline of body; 3, genital and abdominal segments in ventral view; male: 2, dorsal outline of body; 4, ventral view of genital and abdominal segments.

distal angle; no crenulations on dorsal surface of segment 2; segment 3 projects into strong spine; segment 4 produced into a strong tooth, accompanied by spine of about equal length; terminal segment bearing 3 spines on inner margin and 2 small aesthetes on outer margin.

Short strong maxilla with palp and several strong teeth (Fig. 9); 4-segmented maxilliped bearing a few strong setae and several fine hairs (Fig. 10).

Posterior corners of all thoracic segments smoothly rounded; segment 5 noticeably narrower than segment 4, a little narrower than anterior margin of genital segment; genital segment longer than wide, ratio of length to width 1.3 to 1.4:1 (Table 1); genital segment about as long as succeeding abdominal segments; receptaculum seminis malleiform (Fig. 3).

Furcal rami about 3.4 to 3.6 times longer than wide (Fig. 11, Table 1); hairs absent on inner margins; lateral seta arises at about middle of ramus; both dorsal and innermost terminal setae longer than ramus; relative lengths of terminal setae of ramus given in Table 2.

Each ramus of four pairs of swimming legs 3-segmented (Figs. 12-15); attenuation noticeable, particularly in terminal segments; spine formula for segment 3 of exopodites is 2, 3, 3, 3; ratio of length to width of endopodite segment 3 of leg 4 is 3.3 to 3.6:1 (Table 3); inner terminal spine of this segment 2.2 to 2.4 times outer and set at definite angle to axis of segment (Fig. 15); segment somewhat shorter than

TABLE 2. Relative lengths of terminal furcal setae of adult female *Mesocyclops tenuis*

| | Seta 1 innermost | Seta 2 | Seta 3 | Seta 4 outermost | Seta 6 dorsal |
|-------------------------------|---------------------|--------|--------|---------------------|------------------|
| Arizona (Marsh 1913) | 54.5 | 100 | 66.7 | 12.2 | 12.2 |
| Panama (Coker 1943) | 47.5 | 100 | 71.5 | 6.5 | 38 |
| Brazil (Kiefer 1936b) | 47 | 100 | 67 | 12.8 | 34.2 |
| Louisiana | 54 | 100 | 65.5 | 19.4 | 30.6 |
| Paraguay (Lowndes 1934) | 60 | 100 | 73 | 13 | 40 |

inner spine; quotient of length of segment to length of spine is .875 (Table 3); leg 5 2-segmented; the inner spiniform seta and outer terminal seta subequal (Fig. 17).

The male is smaller and slenderer than the female; the length is .65 mm (Fig. 2). Evidence that the male described here as *Mesocyclops tenuis* is by association with *M. tenuis* females and thus circumstantial. The close correspondence in form of male and female appendages coupled with the fact that no other mesocyclopoid females occurred in the samples make the male identification appear reasonable. The mouth appendages and the antennae are very similar to those of the female. The antennule and its armature are depicted in Fig. 18. The only noticeable difference among the swimming legs of the male and female is the marked elongation of the seta on the outer margin of the basipod of leg 1 of the male, thus only the fourth pair is figured (Fig. 19). The shape of the genital segment and spermatophores is shown in Fig. 4. The spiniform seta of leg 5 seems to be somewhat shorter than the terminal seta (Fig. 20). The sixth leg and genital segment are shown in Fig. 21.

That our specimens are referable to the *tenuis* of Marsh seems highly probable but not absolutely certain. Dr. Thomas E. Bowman, United States National Museum, kindly checked and reported that no *tenuis* are cataloged in their holdings. He further indicated that there might be specimens among the uncataloged portion of the Marsh collections.

That Marsh (1910) was dealing with a mesocyclopoid is at once evident from his figure (4) of leg 5 and from his comparison of *tenuis* to *Mesocyclops leuckarti*. Our specimens agree with Marsh's figures and description in the following points: 1) the relative lengths of the seta and the setiform spine on segment 2 of leg 5, shape of the second segment and the position of the setiform spine; 2) the seminal receptacles are similarly shaped; 3) the antennules agree in number of segments and are similar in that segments 3 and 6 are short, 7 is long and 16 and 17 are subequal and relatively long. Furthermore, antennule segments 16 and 17 do not bear a hyaline plate; 4) the relative lengths and widths of the genital segments are similar as are the lengths of the genital segments in relation to the length of the abdomen; 5) the general habituses

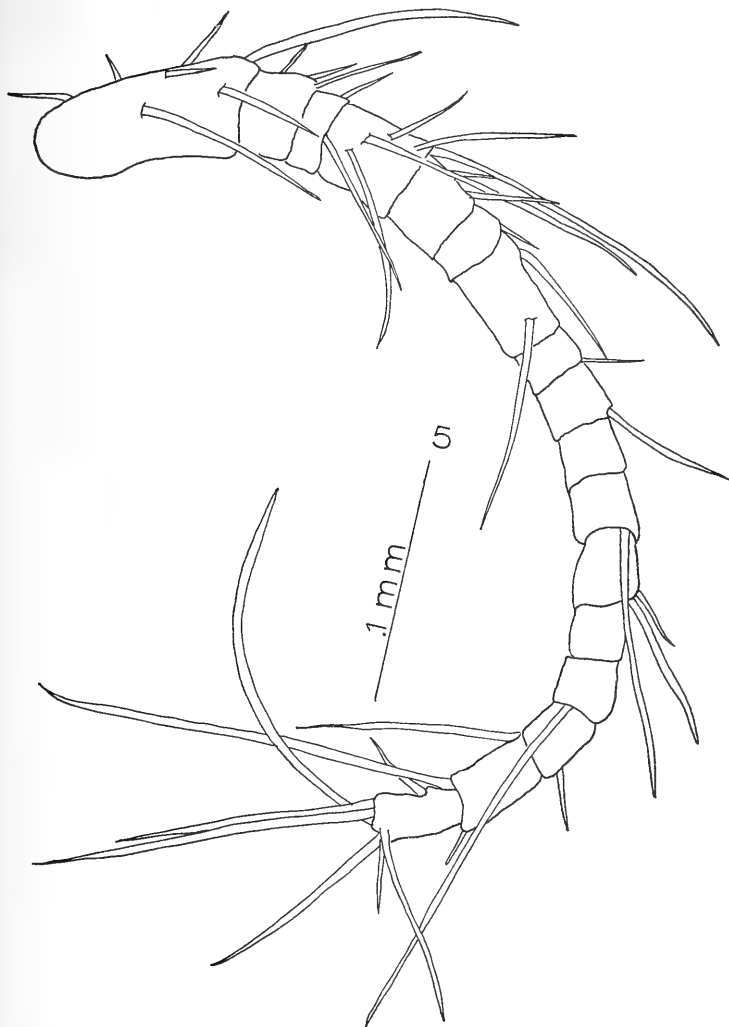


FIG. 5. *Mesocyclops tenuis* (Marsh) female antennule.

are similar, particularly in regard to thoracic segment 5 which is strikingly narrower than either the fourth thoracic or genital segments; 6) the fourth legs are similar in the terminal armature of the endopod and in the generally elongated appearance of all segments of both rami.

More similarities between our specimens and Marsh's *tenuis* can be found by comparing the relative lengths of the terminal setae of the

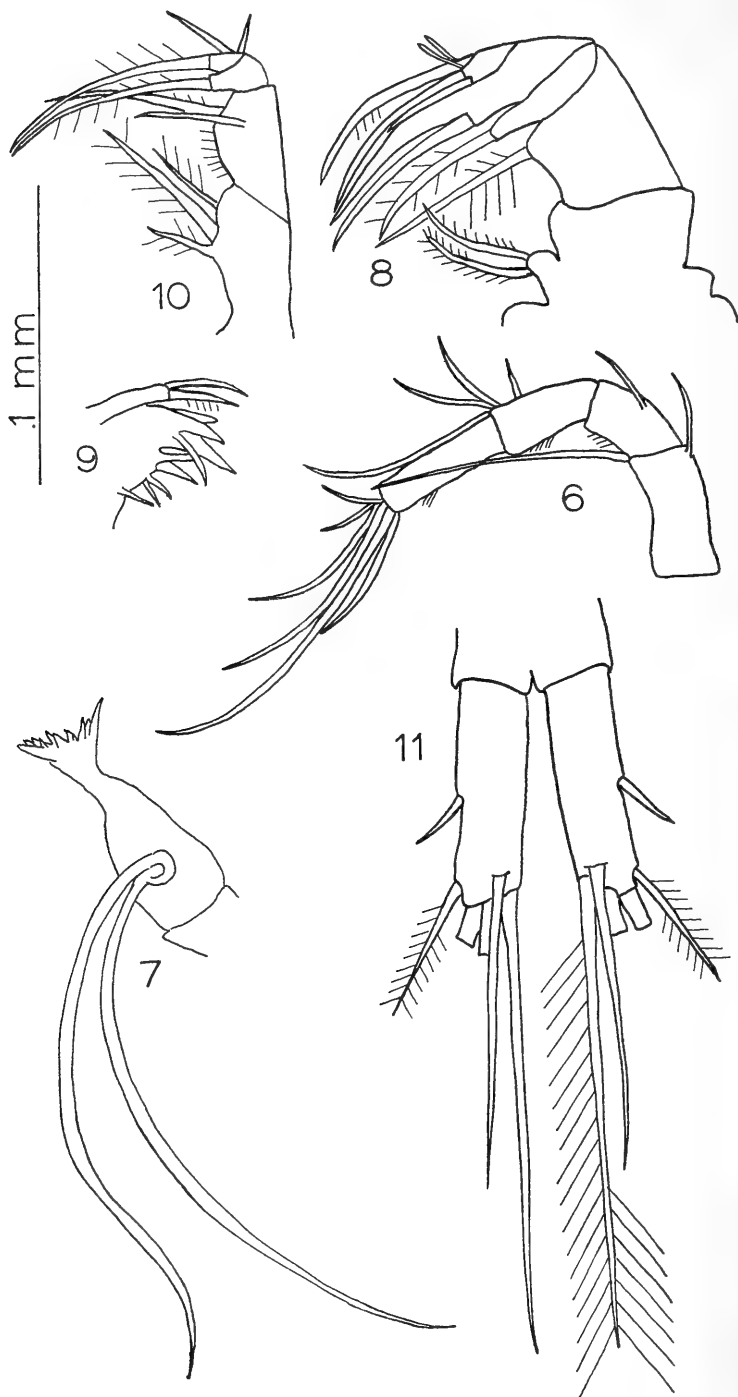


TABLE 3. Morphometric ratios of adult female *Mesocyclops tenuis*

| | Genital segment length/ width | Furcal ramus length/ width | Segment 3 endopod leg 4 length/ width | Terminal spines endopod leg 4 inner/ outer | Segment 3 endopod leg 4 segment length/ inner spine |
|----------------------------|--|-------------------------------------|--|---|--|
| Arizona (Marsh 1910) | 1.3-1.4 | 2.8 | — | — | — |
| Arizona (Marsh 1913) | 1.4 | — | — | — | — |
| Panama (Coker 1943) | 1.2 | 3 | 3.4 | 1.8 | .94 |
| Brazil (Kiefer 1936b) | 1.3 | 3.5 | 3 —3.7 | 2.4 | .87 |
| Louisiana | 1.3-1.4 ¹ | 3.4-3.6 ¹ | 3.3-3.6 ¹ | 2.2-2.4 ¹ | .875 ¹ |
| Paraguay (Lowndes 1934) | 1.16 | 4.5 | 3.2 | 1.9 | .94 |

¹ Based on confidence intervals of Table 1.

furcal rami. Marsh (1913: Plate 3, Fig. 12) figures an Arizona specimen together with two from different localities in Panama. Table 2 gives the relative lengths of the terminal seta, using the longest seta (the second from the inner corner) equal to 100. The values were obtained by measuring the setae on drawings by the different authors where figure measurements were not given. The similarity between Marsh's Arizona animals and our Louisiana animals is at once evident.

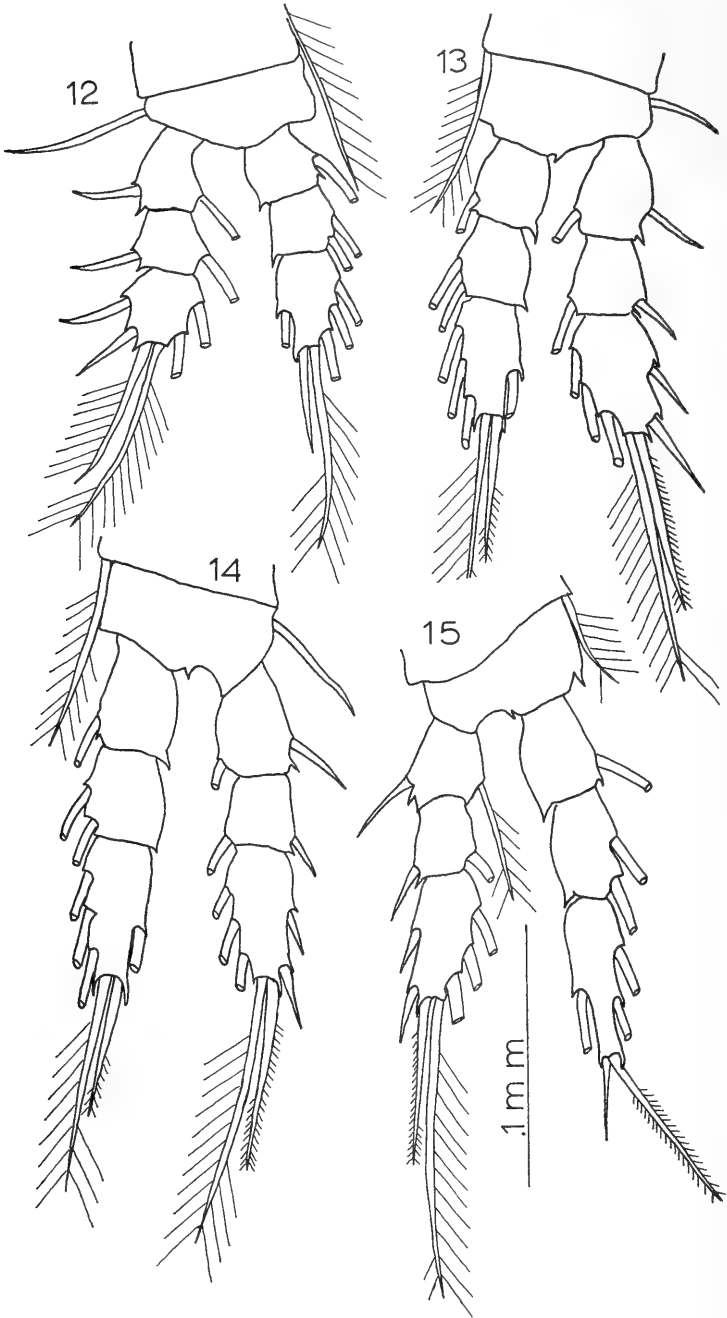
Marsh never recognized any subdivisions of the genus *Cyclops*, preferring to use this name in the broad sense. Sars (1918) erected the genus *Mesocyclops* for those species of Cyclopidae characterized by a malleiform seminal receptacle; antennules elongated and usually 17-segmented; leg 5 bearing on the distal segment two slender subequal setae.

Both Kiefer (1929, p. 78) and Gurney (1933, p. 286) give the presence of a hyaline membrane on antennule segments 16 and 17 as one of the characteristics of *Mesocyclops*. However, Yeatman (1959, p. 811) indicates in his key that some species may not have such a membrane on the ultimate segment of the antennule. Sewell (1957, p. 97) in his review of *Thermocyclops* mentions that specimens of *M. (T.) schmeili* did not show the membranes reported for *M. (T.) oithonoides*, *hyalinus*, *dybowskii*, *inopinus*, *minutus* and *tenuis* (quoting Lowndes 1934 on the latter). Sewell further mentions that for other members of *Thermocyclops* he was unable to find any report of such an armature on the antennules.

Kiefer (1927) recognized two subgenera, *Mesocyclops*, in the strict sense, and *Thermocyclops*, based on the position of the setiform spine on leg 5. Kiefer (1928, 1929, 1930) included *tenuis* in *Mesocyclops*, in

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FIGS. 6-11. *Mesocyclops tenuis* (Marsh) female: 6, antenna; 7, mandible; 8, maxillule; 9, maxilla; 10, maxilliped; 11, furcal rami, dorsal view.



the strict sense; however, he later (Kiefer 1936a) raised *Thermocyclops* to generic rank and placed *tenuis* in this group. Whether the position of one seta is sufficiently important to separate two genera is a moot point. We agree with Gurney (1933) and Sewell (1957) and regard *Thermocyclops* as a subgenus.

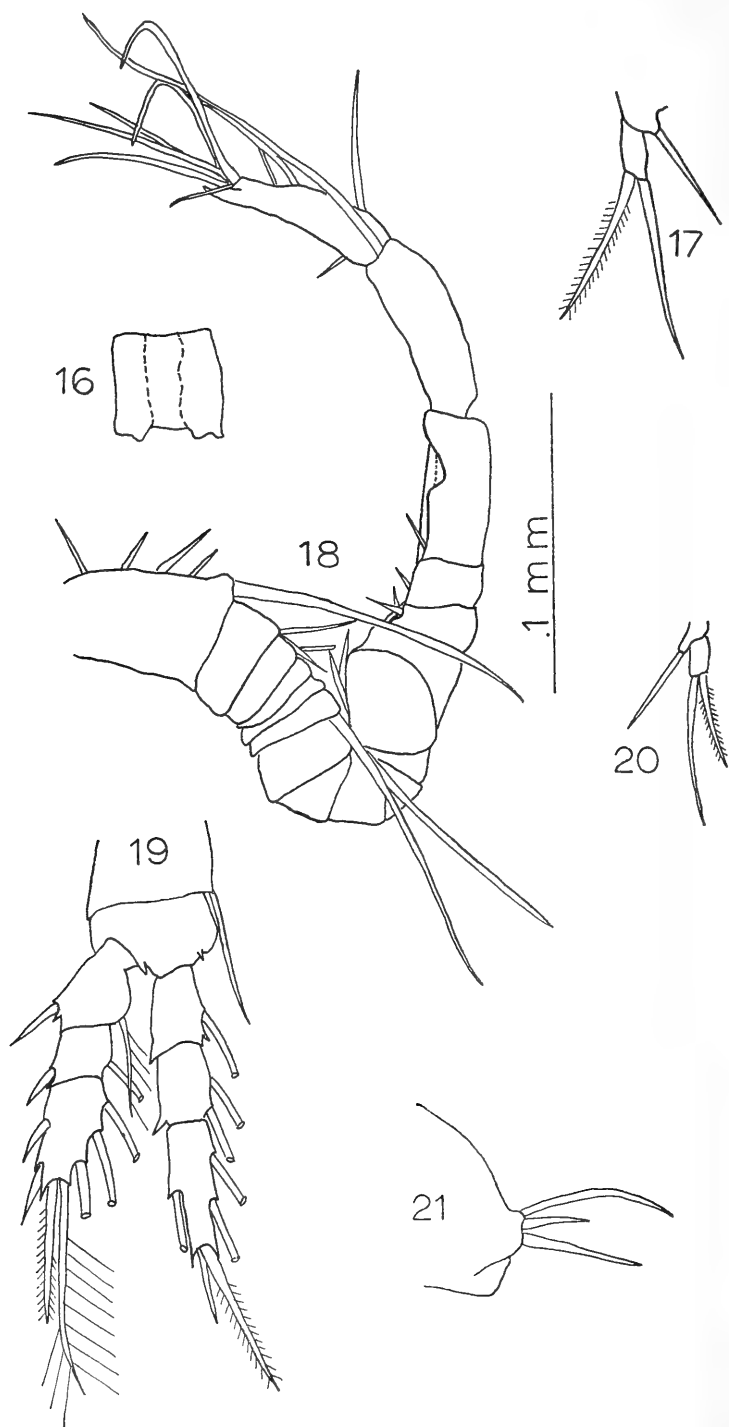
In comparing the Louisiana *tenuis* with described forms of *tenuis* from South and Central America we find that our animals agree with figures and descriptions of Kiefer (1936b) and Coker (1943) and differ from those of Lowndes (1934) (Tables 2 and 3).

One of the most striking differences between our animals and Lowndes' is in the antennule. Lowndes reports a small hyaline plate on segments 16 and 17. We have searched repeatedly for this structure on our specimens and cannot find it. Marsh (1910 and 1913) mentions specifically the absence of a hyaline lamella on *tenuis* and contrasts this to the presence of a plate on *leuckarti*. Coker (1943, p. 192) states that he examined slides of Arizona examples (Marsh's specimens?) and found "indications of a slight hyaline membrane on the two terminal segments of the antenna." He amends Marsh's description to include the possible presence of a poorly-developed membrane. Lowndes states that the antennules reach the hind margin of the second thoracic segment; Marsh states in the original description that the antennule is long "exceeding the second" thorax segment. All Louisiana animals possessed antennules much longer than those reported by Lowndes. The low, unarmed bumps on the connecting plate of the fourth legs (Fig. 16) agree with Kiefer's (1936b) figure and description.

Kiefer (1936b) does not refer to the antennules, thus we cannot determine whether his Brazilian specimens agree with Marsh's specimens or those from Paraguay reported by Lowndes, although he was aware of both Marsh's and Lowndes' papers. Minor discrepancies in relative lengths of terminal setae (Table 2) are inconclusive. However, the presence of the hyaline lamella together with characters of the terminal segment of the endopod of leg 4, proportions of the furcal ramus and of the genital segment (Table 3) and the difference in antennule length lead us to the tentative conclusion that Lowndes' animals may not be referable to *Mesocyclops tenuis* (Marsh). Apparently Marsh found specimens in Panama which he considered identical with *tenuis* from Arizona; however, he noted that some of the Panama animals were much smaller than the northern specimens. After examining Marsh's slides Coker (1943, p. 193) referred at least part of Marsh's animals to *M. inversus* Kiefer. Coker did have specimens from Panama which he considered to be *tenuis* (Figs. 31, 32, 33, p. 189). Kiefer (1936a, p. 133) in describing *Thermocyclops inversus* from Brazil points out that

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FIGS. 12-15. *Mesocyclops tenuis* (Marsh) female swimming legs: 12, leg 1; 13, leg 2; 14, leg 3; 15, leg 4.



this species could be confused with *tenuis* but that characters of the fourth leg distinguish the two species.

Little can be said concerning the ecology of *tenuis*. The Louisiana animals were collected from a "shallow pond in stream bed" 10 miles east of Leesville, Louisiana, 25 July 1952. Yeatman's Kentucky animals came from a "sinkhole pond." Lowndes' specimens identified as *tenuis* came from rain pools in Paraguay. We cannot find any reference by Marsh to the habitat of the Arizona animals. Both Dodds and Marsh reported *tenuis* from a variety of habitats ranging from the open waters of Gatun Lake (Dodds) to small ponds and reservoirs.

In view of possible confusion with other mesocyclopoids the records of *tenuis* in Yucatan cenotes (Wilson 1936 and Pearse and Wilson 1938) must be treated with caution. Coker (1943) examined the El Salvador collection from which Marsh reported *tenuis* and found *inversus*.

In summary, a new record for the occurrence of *Mesocyclops tenuis* Marsh from Louisiana, U.S.A., is reported; additional figures of the female and the first for the male are given. *M. tenuis* seems to be associated with small shallow ponds and is known from Arizona and Louisiana, U.S.A., Panama, Brazil and perhaps Paraguay.

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FIGS. 16-21. *Mesocyclops tenuis* (Marsh) female: 16, connecting plate, leg 4; 17, leg 5; male: 18, antennule; 19, leg 4; 20, leg 5; 21, leg 6.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

NOTES ON THE TAXONOMY OF THE BIRDS OF
MARYLAND AND THE DISTRICT OF COLUMBIA
PART II-PASSERIFORMES

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INTRODUCTION

Since the publication of the A.O.U. Check-list (1957), a number of new distributional records and range extensions of subspecies have been found which affect the status of birds on the Maryland list (Hampe and Kolb, 1947). The purpose of this paper is to point out these additions and changes and to clarify some of the distributional problems relating to geographical variation in the birds of Maryland and the District of Columbia.

This study is based upon a review of the literature and an examination of specimens in the U. S. National Museum, including over 500 specimens collected between 1946 and 1956 as part of a survey of Maryland birds conducted by the U. S. Fish and Wildlife Service. Many of these specimens were used to verify distributional records of species which were later incorporated into a published account (Stewart and Robbins, 1958), but they were not treated subspecifically in that publication.

In this paper, subspecies which are not recognized in the A.O.U. Check-list are enclosed in brackets. Those races which have been described since 1957 are marked with an asterisk. The non-passerines have been considered in an earlier account (Bond, 1957).

I would like to express my thanks for important suggestions and criticisms to Dr. Lester Short, Jr., of the U. S. Fish and Wildlife Service.

Family TYRANNIDAE

[*Empidonax traillii campestris* Aldrich], Traill's Flycatcher

The breeding range of *E. t. campestris* extends across the Northern Great Plains from northern Alberta southeastward to western New York State, and south into the Interior Lowlands to central-eastern Arkansas.

Two specimens of this subspecies have been collected in our area during migration. These are: Laurel, 16 May 1888, and District of Columbia, 20 August 1896.

Family CORVIDAE

Cyanocitta cristata (Linnaeus), Blue Jay

Specimens from Garrett County are referable to the northern form *Cyanocitta cristata bromia* Oberholser in size and color, but birds from the Fall Line and Coastal Plain are quite variable in color and have smaller measurements. They undoubtedly represent populations intermediate in character between *C. c. bromia* and the southern subspecies *C. c. cristata* (Linnaeus). Breeding specimens examined: Finzel, 1; Grantsville, 1; Bittinger, 1; Laurel, 2; Marshall Hall, 1; Upper Marlboro, 1; District of Columbia, 6. Numerous winter specimens taken in Maryland are predominantly of the northern subspecies.

**Cyanocitta cristata burleighi* Bond, Blue Jay

A rather uncommon straggler from Newfoundland (Bond, 1962). Specimen records are as follows: Takoma Park, 18 October 1899; Sandy Spring, 1 February 1891; near D. C., 26 October 1918; Laurel, 26 September 1889.

Family CETHIIDAE

Certhia familiaris nigrescens Burleigh, Brown Creeper

There are three records of this Appalachian subspecies taken in the District of Columbia: 28 October 1880; 6 February 1935; 27 March 1939.

Family TROGLODYTIDAE

[*Troglodytes troglodytes aquilonarius* Burleigh and Peters],
Winter Wren

This pale, well-marked subspecies from Newfoundland is represented in the collection by a specimen at Mt. Querrock, Smithburg, 29 November 1949.

Troglodytes troglodytes pullus (Burleigh), Winter Wren

Migrants of this Appalachian subspecies have been taken from the following localities: Frederick Co., Catocin Creek, between Jefferson and Point of Rocks, 11 November 1949; Prince Georges County, Oxon Hill, 11 October 1929.

Telmatodytes palustris (Wilson), Long-billed Marsh Wren

Birds breeding in the marshes around Chincoteague Bay and Ocean City are closest in coloration to the southeastern coastal subspecies *waynei* Dingle and Sprunt. Breeding specimens from the Washington, D. C. area are intermediate between *waynei* and the inland subspecies *dissaepus* Bangs. Specimens collected during the migration season over many years indicate that both *T. p. palustris* (Wilson) and *T. p. dissaeptus* occur here as transients. Breeding specimens examined: Ocean City, 4 and 27 July 1947; Chincoteague Bay (5 mi. southeast of Snow Hill), 30 May 1922. District of Columbia area: 23 breeding specimens; 41 migrants.

Family TURDIDAE

Hylocichla guttata crymophila Burleigh and Peters, Hermit Thrush

This migrant from Newfoundland is represented by three specimens from our area: District of Columbia, 8 February 1948; Pocomoke Swamp, 28 December 1949; Elliott Island, December, 1947.

[*Hylocichla ustulata almae* Oberholser], Swainson's Thrush

One specimen of this western subspecies (see Bond, 1963) was collected at Ocean City, 10 September 1963.

Family LANIIDAE

Lanius ludovicianus ludovicianus Linnaeus, Loggerhead Shrike

Northward wanderings of this southern subspecies are indicated by the presence of two specimens collected at Largo, 27 November 1948, and Dickerson, 12 February 1950.

Family VIREONIDAE

Vireo solitarius solitarius \leq *alticola*, Solitary Vireo

Mensural characters of four specimens (wing, 75–78 mm; tail, 52–54.5 mm) from Garrett County show that the population from this area should best be treated as intermediate between the larger southern Appalachian subspecies, *V. s. alticola* Brewster, and the smaller northern subspecies *solitarius* (Wilson). Breeding specimens examined: Finzel, 17 and 19 June 1899; Kearney, 18 July 1899; Backbone Mountain, 18 June 1950.

Family PARULIDAE

Dendroica petechia ammicola Batchelder, Yellow Warbler

Two specimens of this subspecies from northern Alaska and trans-Canada have been taken as follows: Assateague Island, 20 September 1945, and Laurel, 9 September 1946.

Dendroica petechia rubiginosa (Pallas), Yellow Warbler

One specimen from the District of Columbia collected on 12 October 1910, has been identified by J. W. Aldrich as a representative of this subspecies from southern Alaska and western British Columbia.

Dendroica coronata hooveri McGregor, Myrtle Warbler

One specimen collected at Laurel, Patuxent Research Refuge, 8 February 1950, has the large measurements of this northwestern subspecies.

Seiurus aurocapillus fuvrior Batchelder, Ovenbird

This Newfoundland subspecies has been recorded from the following localities in migration: Sligo Branch, 23 April 1905; Baltimore, 11 May 1923; District of Columbia, 12 September 1933.

Family ICTERIDAE

Euphagus carolinus nigrans Burleigh and Peters, Rusty Blackbird

One specimen of this Newfoundland subspecies was collected in the District of Columbia, 16 January 1961.

Family FRINGILLIDAE

Pinicola enucleator eschatosus Oberholser, Pine Grosbeak

The A.O.U. Check-list (1957) mentions Assateague Island as a Maryland locality for *Pinicola enucleator leucura* (Muller). I have examined this specimen, taken on 11 November 1945, and find that it is in reality a representative of the Newfoundland subspecies *P. e. eschatosus* Oberholser. There is also another specimen of *eschatosus* taken at Redhouse, Allegheny County, on 23 January 1952.

Passerculus sandwichensis labradorius Howe, Savannah Sparrow

The A.O.U. Check-list (1957) records one specimen of this subspecies collected at Ocean City. There are three others taken in the District of Columbia: 3 April 1861; 5 April 1899; and 14 February 1891.

Passerculus sandwichensis oblitus Peters and Griscom,
Savannah Sparrow

One specimen of this subspecies from central Canada was collected at Doub, Frederick County, 29 October 1949.

Passerella iliaca zaboria Oberholser, Fox Sparrow

The breeding range of this subspecies extends from Alaska east to Manitoba. Two specimens have been collected in our area during migration: Bladensburg, 21 November 1959, and Pocomoke Swamp, 28 December 1949.

Melospiza georgiana ericrypta Oberholser, Swamp Sparrow

This subspecies breeds in Garrett County. There are a number of

specimens in the collection taken in other parts of the State during migration: Laurel, Plummer's Island, Burnt Mills, Mills Island, Cornfield Harbor, and Baltimore County are examples of some of them.

Melospiza georgiana nigrescens Bond and Stewart, Swamp Sparrow

This subspecies breeds in the brackish marshes of the Eastern Shore from Vienna to the Delaware Bay. One specimen in streaked juvenal plumage was taken on the western shore one mile south of Hills Bridge on the Patuxent River, 9 August 1962.

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PROCEEDINGS
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PARALIPARIS WILSONI, A NEW LIPARID FISH
FROM THE GULF OF GUINEA

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Commercial Fisheries, Miami, Florida*

During a bottom trawling survey carried out from the U. S. Bureau of Commercial Fisheries R/V GERONIMO, off Gabon, West Africa, in September 1963, a fish specimen was caught which represents a new species in the family Liparidae.

Paraliparis wilsoni new species

Holotype: United States National Museum no. 198201, a female, 215.0 mm, standard length, caught off Gabon, West Africa, in a 40-foot shrimp trawl from the U. S. Bureau of Commercial Fisheries R/V GERONIMO cruise 2, station 240, 04°08'S-010°08'E; depth 1134 meters; 9 September 1963.

Diagnosis: A *Paraliparis* with simple teeth in a single series, 24 pectoral rays, and many rudimentary pores extending posteriorly in a single line along the body behind the single suprabranchial pore.

Counts and measurements: The measurements are in millimeters, and percentages of standard length are in parentheses. The counts of vertebrae, dorsal fin rays, anal fin rays, and caudal fin rays are from radiographs. Greatest body depth 47.6 (22.1); body width at level of anal fin origin 15.4 (7.2); greatest head width 29.5 (13.7); head length 36.4 (16.9); eye 8.9 (4.1); snout length 12.3 (5.7); interorbital width 16.5 (7.7); gill slit 6.1 (2.8); snout to posterior tip of pectoral fin 62.0 (28.8); length of upper lobe of pectoral fin 21.0 (9.8); length of lower lobe of pectoral fin 8.3 (3.9); snout to anus 39.0 (18.1); dorsal rays 63; anal rays 56; pectoral rays 24; caudal rays 8; vertebrae 12 + 58 = 70, including hypural; branchiostegals 6; abdominal caecae 6, all on left side; cephalic pores include 2 on snout, 6 in a series extending along lower margin of snout and curving dorsally to above and behind the eye, and 7 in a series extending from tip of lower jaw to opercle; 1 suprabranchial pore above the gill slit.

Description: A moderately slender and compressed fish with greatest body depth (just behind head) 4.5 in standard length; body width at

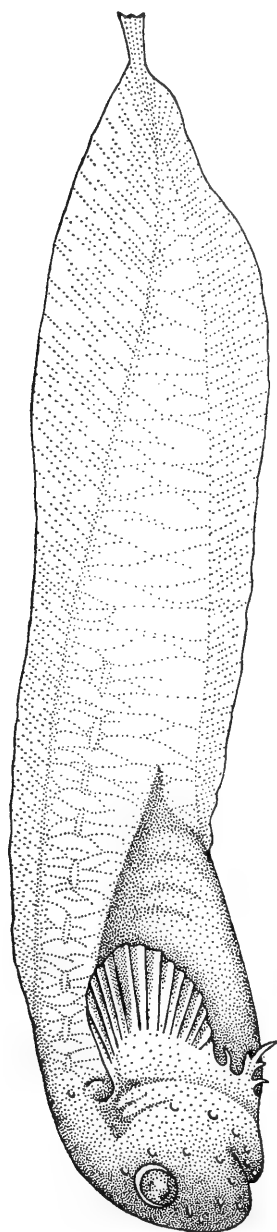


FIG. 1. Holotype of *Paraliparis wilsoni*, 215.0 mm in standard length. Drawn by Lorraine Pilon Sund.

level of anal fin origin, 14.0 in standard length. Skin smooth, lacking prickles, and very loose on body and fins.

Dorsal fin origin a short distance behind vertical from gill slit; dorsal fin unnotched, height increasing from origin, and highest at about fin rays 43–50. Anal fin origin at posterior end of abdominal cavity, at a distance from vent of 4.1 in standard length. Pectoral fin deeply notched; nineteenth ray, counting dorsal to ventral at apex of notch.

Head slightly deeper than broad in opercular region. Snout protruding over the inferior mouth; snout length 3.0 in head. Eye large, 4.1 in head; pupil round. Nostril single and oval without a flap, resembling a cephalic pore, and located midway between posterior snout pore and anterior edge of eye. At least 10 rudimentary pores extend posteriorly on body from suprabranchial pore. Very small simple teeth form a row on the premaxillary and dentary bones, but are absent at the premaxillary symphysis. Prevomerine and palatine teeth not discernible. Gillrakers not discernible. Gill opening small, 6.0 in head, and located directly above pectoral fin base.

Skin semi-transparent and covered with many small brown chromatophores. Chromatophores arranged in a diffuse, vertically oriented pattern on body; concentrated on anterior part of head and on fin edges, giving these areas a dark appearance. Eye, interior of mouth, gill cavity, gill slit, peritoneum, vent, strip posterior to vent on abdominal cavity, and rectal portion of gut black. Dorsal outline of abdominal cavity black, with black streaks curving anteroventrally. Body has a few irregular black spots, particularly near region of abdominal cavity. Gut white, except in rectal area.

Relationships: The genera *Careproctus* Kroyer and *Paraliparis* Collett are very similar in many characters (Burke, 1930). The presence of a ventral disk and rudimentary pores in *Careproctus* and their absence in *Paraliparis* are the two most important distinguishing characters. However, *P. wilsoni*, while lacking any vestige of a ventral disk, does have rudimentary pores on the body. Therefore, the generic allocation of this species is tentative.

If *P. wilsoni* is correctly placed in *Paraliparis*, then its closest relative is probably *P. copei* Goode and Bean, the only other Atlantic species with simple teeth in a single series. The single specimen of *P. wilsoni* differs from *P. copei* in having: rudimentary pores on the body posterior to the suprabranchial pore (none on *P. copei*); more pectoral rays (21–22 in *P. copei*); and a different color pattern (*P. wilsoni* is very dark and has a distinct chromatophore pattern, whereas *P. copei* is light, except on the snout and fin edges, and has no recognizable chromatophore pattern). No reliable distinction between *P. wilsoni* and *P. copei* is apparent in the numbers of dorsal rays, anal rays, or vertebrae (the numbers in *P. copei* are, respectively: 61–64, 57–60, and 68–71).

Specimens of P. copei examined: U. S. 35637, the holotype, 160.9 mm in standard length, collected at R/V ALBATROSS station 2232, 39°12'17"N–072°09'30"W; depth 520 fathoms; 13 September 1884.

U. S. 186151, 139.4 mm in standard length, collected at R/V DELAWARE station 59-10, 39°47'N-070°57'W; depth 800 fathoms; 27 August 1959.

Acknowledgments: Dr. Daniel M. Cohen, U. S. Bureau of Commercial Fisheries, provided much advice as well as the X-rays of *P. wilsoni* and of the two specimens of *P. copei* examined. He also critically read the manuscript. Mr. J. Blache, Museum National d'Histoire Naturelle, Paris, France, made several valuable suggestions.

P. wilsoni is named for Mr. Robert C. Wilson, U. S. Bureau of Commercial Fisheries, who conceived and directed the trawling survey during which this new species was collected.

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Contribution No. 28, Tropical Atlantic Biological Laboratory, Bureau of Commercial Fisheries, Miami, Florida.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW SPECIES OF *HETEROGEOMYS*
(MAMMALIA : GEOMYIDAE) FROM HONDURUS

BY WILLIAM B. DAVIS

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In the course of biological investigations on the Caribbean slopes of northern Honduras in 1964-65, four adult or near adult specimens of pocket gophers which appear to represent an undescribed species of the genus *Heterogeomys* were taken near Tela, Province of Atlantida. For this population I propose the name

***Heterogeomys hondurensis* new species**

Holotype: Adult male, skin and skull, no. 12570, Texas Cooperative Wildlife Collections, collected 17 December 1964, by Jerome V. Mankins 8 miles west of Tela, Province of Atlantida, Honduras, elevation 10 feet; original no. 4772.

Diagnosis: A large, sparsely-haired *Heterogeomys*; pelage hispid, brown to near Seal brown in color above; underparts nearly naked; skull similar to that of *H. hispidus*, but premaxillae terminate posteriorly at or near the anterior point of juncture of the frontal with the maxillary arm of the zygoma (considerably anterior to a line drawn through the lacrimals; see Fig. 1); rostrum broad and short, its breadth 135-145 percent of interorbital breadth.

Measurements (mm): Holotype followed in parentheses by a male paratype (TCWC 12571): Total length, 333(336); tail, 99(98); hind foot, 47(46); condylobasal length, 62.6(64.3); zygomatic breadth, 42.5(43.2); nasals, 25.2(25.5); mastoidal breadth, 37.0(38.0); interorbital breadth, 12.2(11.7); alveolar length of maxillary toothrow, 14.0(14.2); weight (gm), 563.8(541.8).

Of two female paratypes (TCWC 12573 and 12572, respectively): Total length, 330, 330; tail 100, 99; hind foot, 47, 47; condylobasal length, 59.5, 61.4; zygomatic breadth, 38.9, 40.0; nasals, 23.7, 23.9; mastoidal breadth, 36.7, 37.2; interorbital breadth, 11.3, 12.0; alveolar length of maxillary toothrow, 14.0, 13.7; weight, 409, 404.6.

Comparisons: The Honduran specimens differ from all races of *H. hispidus* examined (*hispidus*, *torridus*, *yucatanensis*, *cayoensis* and

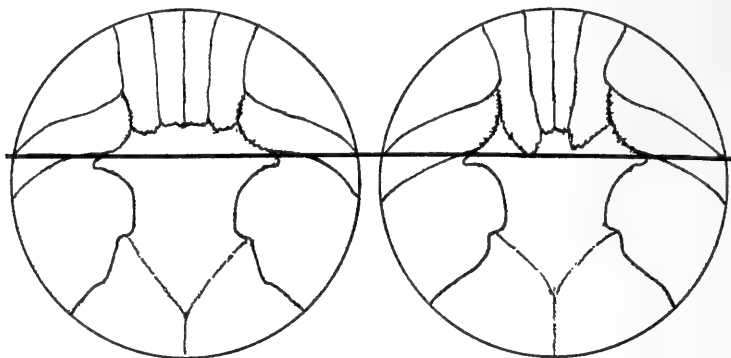


FIG. 1. Comparison of the dorsal aspect of the skulls of *Heterogeomys hondurensis* (left) and *H. hispidus* (right). Note the position of the premaxillae relative to a plane drawn through the lacrimals.

chiapensis) in the shortness of the posterior extension of the premaxillae (see Fig. 1). Additionally, *hondurensis* differs from *H. h. chiapensis* in attaining a larger size and in having a much coarser pelage and relatively longer tail; from *yucatanensis* in attaining a larger size; from *cayoensis*, from British Honduras, in having a harsher pelage and a proportionately longer tail.

Remarks: In the highland populations *chiapensis* and *cayoensis* the tail is relatively short (about 36% of length of head and body), whereas in the lowland populations, *yucatanensis* and *hondurensis*, it is relatively longer (44% of length of head and body). In specimens of *hispidus* (uplands) and *torridus* (lowlands) from Veracruz the same situation exists, but the percentages are different (34% in *hispidus*, 39% in *torridus*).

Upland populations also have softer, denser pelage and, in instances where comparative weights are available, heavier bodies. For example, weights of adult *hispidus* from near Jalapa, Veracruz, vary from 725 to 852 grams with no significant sexual difference; those of *torridus* from near the city of Vera Cruz vary from 448 to 548 with males significantly heavier than females. The four specimens from Honduras vary from 405 to 409 in adult females to 542 to 564 in adult males. All specimens from lowland areas have sparse, harsh pelage; in some instances so sparse that the animal appears to be nearly naked.

Additional material may demonstrate that *hondurensis* intergrades with *H. hispidus*; however, all available specimens of *hondurensis* are readily distinguished from the 23 specimens of *hispidus* examined by the cranial features depicted in Fig. 1.

This is the first reported occurrence of *Heterogeomys* in Honduras. According to Mankins, this pocket gopher is a serious pest in the oil palm plantations near Tela.

Comparative materials were made available by the Museum of Zoology, University of Michigan; the U. S. National Museum; and the American Museum of Natural History. To the individuals in charge of those collections I wish to express my appreciation for their assistance.

Specimens examined: Four, all from the type-locality.

Contribution no. TA 5217 of the Texas Agricultural Experiment Station.

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

THE CHUKAR PARTRIDGE (AVES) OF ST. HELENA
ISLAND, SOUTH ATLANTIC OCEAN

BY GEORGE E. WATSON

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Four specimens of Chukar Partridge, *Alectoris chukar*, from the population introduced on St. Helena Island in the South Atlantic Ocean ($15^{\circ} 28' S$, $5^{\circ} 42' W$) caught my eye in the British Museum during a visit in 1960. They and an immature specimen in the Yale Peabody Museum "Blossom" collection were not only as pale as the palest subspecies, *A. c. werae*, from southwest Iran, as has been noted by Benson (1950: 81) and inferred by Gosse (1938: 17, 425), but unlike that population were very short winged. When Raymond A. Paynter, Jr., offered to get some fresh specimens for the Museum of Comparative Zoology through Arthur Loveridge, who now lives on St. Helena, I urged him to do so. A pair sent by Loveridge are likewise very pale and small.

This combination of characters corresponds with those of no recognized subspecies from the known natural range of this Palearctic species (Vaurie, 1965). Although the number of specimens available is too small to provide an adequate sample of the full range of variation in the St. Helena Island population, it is worthwhile to describe the general appearance of the population and, on the basis of morphology and known early trade routes, to speculate on the origin of the introduced population.

The St. Helena Chukars are very near in color to the palest and greyest subspecies, *A. c. werae*, but in comparable fresh plumage they are slightly paler still, purer grey and less sandy on the upperparts and more cream than buff on the abdomen. They are smaller than *werae*, however, 4 males measuring 156-160 mm, average 158 mm and 2 females 146 mm and 148 mm against 166-176 (170.1) for 9 males of *werae* and 155,

158, and 165 in 3 females. The St. Helena birds are thus similar in size range to Aegean Island Chukars, *A. c. kleini*, *cypriotes*, and *scotti*, of which 31 males measure 152–165 (157.8) and 25 females 146–155 (149.9). Aegean birds like those of the Himalayas, *A. c. chukar*, are much darker; in fact *kleini* and *chukar* are the darkest of all Chukar subspecies.

St. Helena is a small volcanic island 17.5 km long, 10 km wide and 818.4 m high, lying 1835 km from the west coast of Africa in the path of the Southeast Trade Winds. It was formerly forested, but man and his domesticated animals decimated the trees by the early 19th Century and much of the present lowland cover is scrub. The Chukars are apparently restricted to the more remote, barren and arid cliffs and cactus-covered hillsides of the western end of the island. According to Haydock (1954: 68) and Loveridge (letter to Paynter, 1963) they are at present neither abundant nor easy to obtain.

The Chukar Partridge was already established on St. Helena in 1588 when Thomas Cavendish called at the island and noted that the "great store" of "very tame" partridge were "almost as big as hens and . . . of an ash colour" (Callander, 1766: 468). Both Gosse and Benson believe that the St. Helena Chukar came originally from Persia, presumably on the basis of its resemblance to *werae*. Melliss (1870: 103), on the other hand, suggested that the original stock came from northern India within the range of the nominate subspecies:

"Although there appears to be no record to show whence the partridge was introduced to St. Helena, it is most probably the Chukar-Partridge of Northern India; and as it differs somewhat in plumage, possibly the change of climate or food may have produced the change. A closer examination of the bird, however, is desirable."

All of the Chukar Partridge stocks that have been kept in captivity in western Europe or America or which had been introduced around the world prior to 1950 apparently were ultimately derived from the Himalayan stock, *A. c. chukar*. This very dark subspecies is one of the larger ones, its wing measurements being similar to those of *A. c. werae*. It is easy to keep in captivity (Jerdon, 1864: 566) and today is frequently seen in the markets of India (Biswas, personal communication, 1962). Chukar Partridge of various other subspecies, including *werae*, are kept also at present as cage birds in Iran (Trousedale, personal communication, 1965) and presumably also were in Persia four hundred years ago.

During the 16th Century, there was frequent trade between Lisbon and the Portuguese colonies in India and Persia. St. Helena was an important stopover for vessels on the return voyage to Europe after round-trip in the Cape of Good Hope. Goa, which is the best known colony in the area and the one most frequently mentioned in Gosse's history of St. Helena (1938: 1–36), lies 1600 km south of the range of the Hima-

layan Chukar. There was also, however, an important Portuguese colony at this time at Gumbroon (present-day Bandar Abbas) in the Strait of Hormuz between the Persian Gulf and the Gulf of Oman (Trousdale, personal communication, 1965). Bandar Abbas lies well within the range of *A. c. werae*. Thus, the earliest introductions of chukars on St. Helena may have come from either India or Persia, but as Melliss pointed out, there are no early records available. Any further introductions which might have taken place during English hegemony over the island after 1658 would have been most probably of Himalayan stock brought in by the ships of the East India Company (Haydock, 1954: 68).

The Chukar Partridge is a plastic species varying in color apparently in response to environmental factors, particularly humidity. It is unknown, however, whether geographic differences in color in this species (Watson, 1962; Vaurie, 1965) are due to adaptation, to climate, or to selection for cryptic plumage by predation, nor is it known whether the differences are genotypic or merely phenotypic. There is some geographic variation in size but it is slight except on islands in the Aegean Sea where Chukars tend to be especially small (Watson, 1962), possibly due to the rigors of life in seasonably dry, insular environments.

The two meteorological stations on St. Helena report very different precipitation figures (Great Britain Meteorological Office, 1958). Average annual rainfall at the higher, Hutt's Gate, 628 m, is 821 mm, whereas at Jamestown, 12 m, it is only 140 mm. In northern India near Simla, 2213 m, one of the driest portions of the range of *A. c. chukar*, annual rainfall is 1590 mm. The native environment of *A. c. werae* in the foothills of the Zagross Mountains, however, is quite arid; annual rainfall at Bandar Abbas, 9 m, is only 150 mm, almost all of which falls from December to February.

The present-day similarity in color between the Zagross and St. Helena Chukar populations, Cavendish's implication that in 1588 the St. Helena birds were likewise noticeably gray, the general similarity in rainfall between southwest Iran and at least the lower portions of St. Helena, and the early trade routes, suggest that Chukars were introduced originally to the island from southwest Persia and have differentiated locally somewhat, notably in size. Furthermore, the fact that the population is even paler and grayer than the Zagross population suggests that there were no later introductions from India.

Rapid differentiation of introduced populations has already been demonstrated in the House Sparrow, *Passer domesticus*, in the United States (Johnston and Selander, 1964) and the St. Helena Chukar Partridge offers additional evidence that previous estimates of evolutionary rates for infraspecific characters in birds (Moreau 1930, Mayr 1963: 579) may have been too low.

I am grateful to Mr. J. D. Macdonald of the British Museum and to Dr. Charles Vaurie of the American Museum of Natural History for permitting me to examine the extensive series of *Alectoris* partridge

under their care, and to Mr. Biswamoy Biswas of the Bombay Natural History Museum, and Mr. William Trousdale of the Freer Gallery for information on partridges and Portuguese colonial history. I am particularly indebted to Dr. Paynter and Mr. Loveridge for securing the additional specimens for my examination.

St. Helena material examined: Museum of Comparative Zoology (MCZ) 285844 adult ♂, flats above Bennetts Point, west side of St. Helena, 29 March 1963; MCZ 262144 adult ♀, Horse Pasture, northwest St. Helena, 13 March 1963; British Museum (BM) 1909-8-1-2 (♂, not sexed by collector) St. Helena, 25 April 1908; BM 1935-5-4-1 (♂, not sexed by collector) St. Helena, no date; BM 1936-9-20-3 ♂, St. Helena, 1-15 July 1936; BM 1936-9-20-4 ♂, St. Helena, 1-15 July 1936. Yale Peabody Museum 44609 juvenile ♀ in 1st prebasic molt (primaries not fully grown), St. Helena, 1 October 1925.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

A NEW TRIBE AND A NEW SPECIES OF
OPHIDIOID FISH

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Among the shallow-water, viviparous ophidioids with a separate caudal fin and a hard copulatory apparatus, is a group of several genera which are more closely related to each other than to the *Dinematichthys-Ogilbia* group with which some of them have been confused. Even though much is yet unknown about the species and genera, at this stage in our knowledge of these fishes it seems more desirable to emphasize phyletic *differences* rather than *similarities*. Therefore I propose to segregate these forms into a tribe which is diagnosed below.

I am indebted to the following individuals who have assisted me by commenting on parts of the manuscript. Dr. Bruce Collette, Mr. Charles Dawson, Dr. William Gosline, Mr. R. J. McKay, Dr. Victor Springer, and Dr. Boyd Walker. Curators who have helped me by lending specimens are: Dr. James Böhlke, Academy of Natural Sciences of Philadelphia (ANSP); Mr. R. J. McKay, Western Australian Museum (WAM); Prof. J. L. B. Smith, Rhodes University (RU); and Dr. Frank Talbot, South African Museum (SAM) and Australian Museum (AM). Dr. Talbot has been particularly patient with me, in Cape Town and Sydney, and it is a pleasure to name for him the new species described in this paper.

Definitions of terms and abbreviations are given in Cohen (1964).

DERMATOPSINI, new tribe

Type-genus *Dermatopsis* Ogilby, 1896

Diagnosis: Small, secretive, viviparous ophidioids with a single pair of hard genital claspers (Figs. 2, 4, 5); scales nonimbricate or at most barely overlapping; scales probably lacking on head, but if present, only as a few scattered scales, not as a discrete patch; posterior end of maxillary not greatly expanded vertically (Fig. 1A).

Relationships: Dermatopsini is most closely related to the *Dine-*

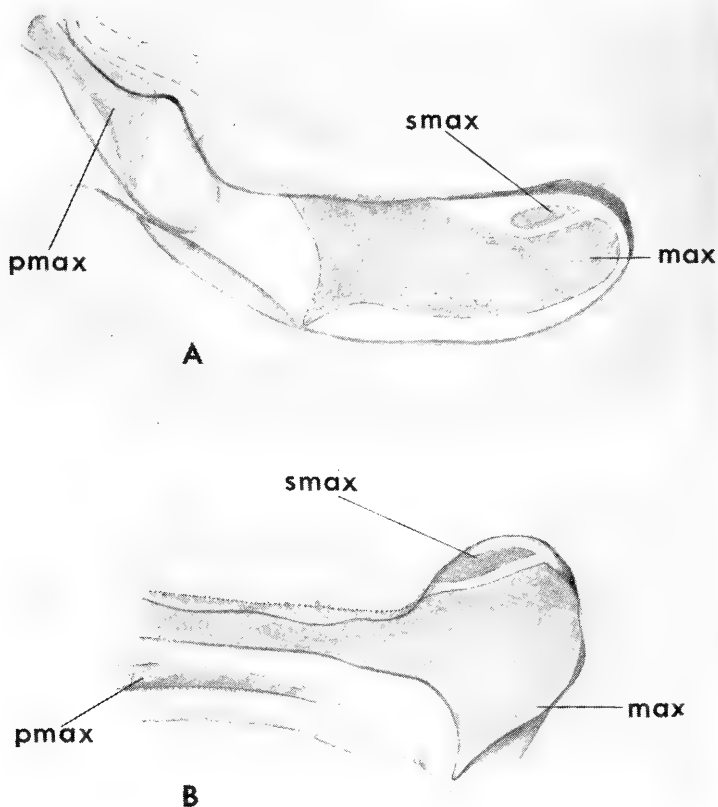


FIG. 1. Alizarin preparations of maxillary bones. Max, maxillary; pmax, premaxillary; smax, supramaxillary. A. Horizontally elongated maxillary of *Dermatopsis macrodon*, ANSP-WAS-NZ-1 (see text for data). B. Vertically expanded maxillary of *Ogilbia* sp. from USNM 199541, *Te Vega* stat. 106, Indonesia, Mentawai Islands, Pulo Mega; lat. 04°01'S, long. 101°01'30"E. Drawn by Mildred H. Carrington.

matichthys-Ogilbia group, which differs in having multiple pairs of claspers (Turner, 1946), imbricate scales on the body, patches of scales on the head, and the posterior end of the maxillary vertically expanded (Fig. 1B).

Unsolved nomenclatural and zoological problems preclude the presentation of additional discussion or a more formal designation for the *Dinematichthys-Ogilbia* group.

Genera: In addition to the type-genus, I refer to this tribe *Dermatopsoides* Smith, 1947; an as yet undescribed genus from the Gulf of Mexico (Dawson MS); and possibly *Diancistrus* Ogilby, 1898.

Discussion: Four species of small, viviparous ophidioids from the Australia-New Zealand region require comment.

1. *Dinematichthys consobrinus* Hutton, 1875 was described from New Zealand and later figured by Hector (1877). Ogilby (1897) suggested that it might be a species of *Dermatopsis*. The figure shows a relatively short-bodied fish with imbricate scales and the posterior end of the maxillary bone vertically expanded. This species is probably a member of the *Dinematichthys-Ogilbia* group.

2. *Monothrix polylepis* Ogilby, 1897 (monotypic genus) was described from New South Wales and later figured by Whitley (1935). Ogilby suggested relationship with *Dinematichthys piger* Alcock, which he did not think belonged in *Dinematichthys*. The numerous imbricate scales and the shape of the maxillary exclude *M. polylepis* from the Dermatopsini.

Schultz (1960, p. 385) placed *Dermatopsis kasougae* Smith (type-species of *Dermatopsoides*) in the genus *Monothrix*. This would make *Dermatopsoides* a junior synonym of *Monothrix*. On p. 388 of the same paper he listed *Dermatopsoides* as a synonym of *Dinematichthys*. As I show in this paper, these allocations are untenable.

3. *Diancistrus longifilis* Ogilby, 1898 (monotypic genus) was described from Lord Howe Island. I have found no figure or other account of this species in the literature. Schultz (1960) placed *Diancistrus* in the synonymy of *Dinematichthys* with no comment. I believe *Diancistrus* is a valid genus and I tentatively refer it to the Dermatopsini based on the following characters (from the description) in which it resembles several dermatopsine species: head naked, maxillary spatulate, gill membranes united in front, a pair of curved claspers, anal fin united by a membrane to the base of the caudal fin.

4. *Dipulus caecus* Waite, 1905 (monotypic genus) was described and figured from off Fremantle. Waite suggested relationships with the deep sea viviparous ophidioid genera *Aphyonius* Günther and *Sciaodonius* Garman. Mees (1962) re-examined the holotype and considered it to represent a species of *Dermatopsis* closely related to *D. multiradiatus* McCulloch and Waite, thus relegating *Dipulus* to the synonymy of *Dermatopsis*. Mees identified a series of specimens from near Perth (Rottnest Island) as *Dermatopsis caecus* (Waite). I quote (p. 28), "The type specimen of *Dipulus caecus* is in the collection of the Western Australian Museum, and although it is in poor condition there can be no doubt about its identity with the fresh material."

I have examined some of Mees' material, and I find it to include three species of ophidioids: a species of *Dinematichthys* (Mees, 1960, reported *D. iluocoeteoides* Bleeker from Rottnest Island); *Dermatopsis multiradiatus*; and *Dipulus caecus*. Mees has confused *D. multiradiatus* and *D. caecus*; my examination of his material shows that these two spe-

cies differ in many characters. Fin ray and vertebral counts on four specimens of *D. caecus* show 173 to 183 dorsal fin rays, 112 to 120 anal fin rays, and 81 to 86 vertebrae (compared with 98 to 114 dorsal, 64 to 72 anal, and 51 to 55 vertebrae in *D. multiradiatus*; see tables 2, 3, and 5 for frequency distributions). *Dipulus caecus* also has a more elongate body with depth at vent 7.2 to 7.6 percent SL (8.8 to 11.7 percent in *D. multiradiatus*); and a proportionately shorter head, 11.5 to 13.1 percent SL (15.9 to 20.2 percent in *D. multiradiatus*). Other differences are: scales absent in *D. caecus*, present in *D. multiradiatus*; claspers broad, complex, and convoluted in *D. caecus*, not as in *D. multiradiatus* (Fig. 4 B). The two species show many other differences in proportions and in the number and position of head pores.

Several items in the original description of *D. caecus* require discussion. Waite described and figured the dorsal and anal fins as continuous with the pointed caudal fin. R. J. McKay of the Western Australian Museum examined the holotype at my request, and he has written to me that, "The holotype has the caudal fin badly damaged but apparently the dorsal and anal fins were joined to the caudal fin *at the base* of the caudal fin only." This agrees with the tail fins of the specimens which I identify as *D. caecus*. Mr. McKay further wrote ". . . I am unable to ascertain whether the caudal fin of the type was as pointed as Waite illustrates." The caudal fin is rounded in my specimens. The original description of *D. caecus* states that external eyes are lacking in the holotype, a circumstance which McKay has confirmed. The specimens that I have examined all have small but conspicuous eyes, and it therefore seems likely that the holotype is aberrant in this respect. Based on the literature, Thines (1955) included *D. caecus* in a list of blind fishes. In a later paper (1960), however, he examined specimens identified as *D. caecus* and noted the existence of small, but well developed eyes. He gave no information on how his specimens were identified and his observations could have been made on *Dermatopsis multiradiatus* rather than on *Dipulus caecus*.

I recognize *Dipulus* as a valid genus. A proper assessment of its relationships requires further study, and for the present I must relegate it to ophidioid limbo.

Genus *Dermatopsis*

Dermatopsis Ogilby, 1896, p. 138 (type-species by monotypy, *Dermatopsis macrodon* Ogilby, 1896).

Diagnosis: Chin barbel absent. Gill membranes broadly joined to isthmus. Livebearing; male genitalia consisting of fleshy hood, two flattened claspers directed laterally at their distal ends, and penis. Ventral fins immediately adjacent to each other, each with single ray, fins not originating immediately behind symphysis of cleithra, but placed about an interorbital distance behind. Caudal fin free, with 16 or more rays; pectoral fin entire, without separate, elongated rays. Scales lacking on

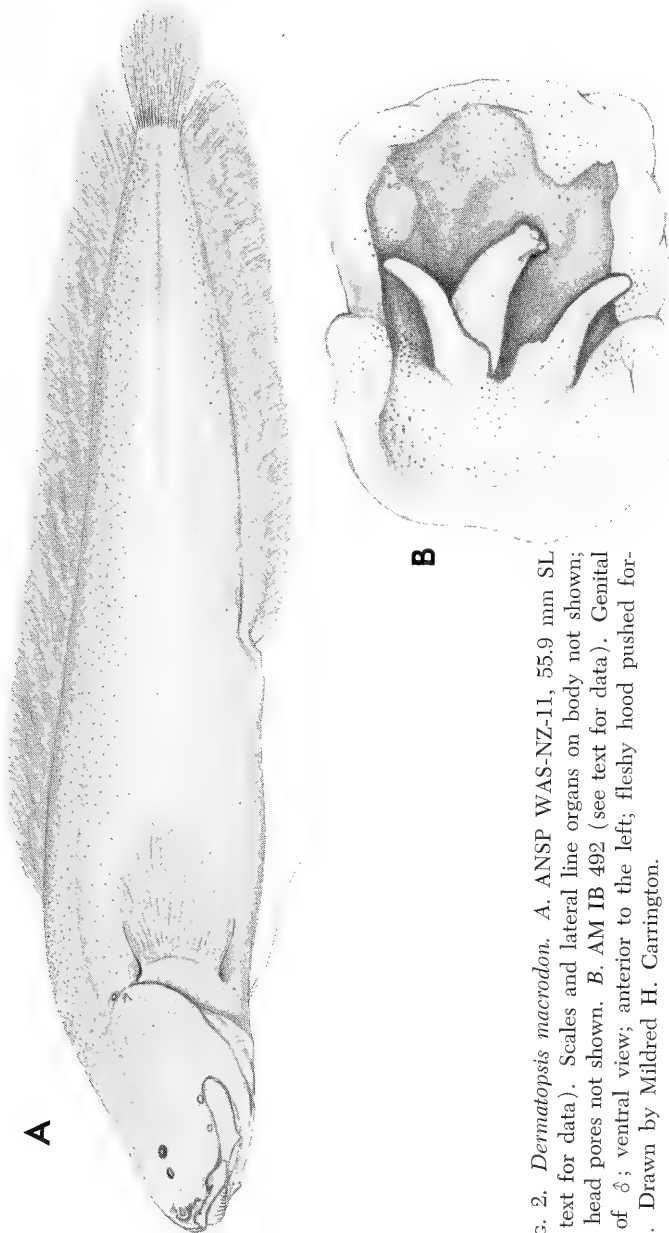


FIG. 2. *Dermatopsis macrodon*. A. ANSP WAS-NZ-11, 55.9 mm SL (see text for data). Scales and lateral line organs on body not shown; some head pores not shown. B. AM IB 492 (see text for data). Genital area of ♂; ventral view; anterior to the left; fleshy hood pushed forward. Drawn by Mildred H. Carrington.

head, non-imbricate on body. A short, sharp spine at upper angle of opercle. Anterior nostril tubular, located directly above upper lip; gill rakers reduced. Branchiostegal rays 6. Lateral line of minute delicate papillae (not visible in most specimens). Teeth present on premaxillary, vomer, palatine, and dentary; maxillary elongated posteriorly but not vertically expanded. Eyes small. Peritoneum pale.

First neural spine shortest; neural spines on abdominal centra with sharp tips. Vertebrae 1 through 5 or 6 with ribs articulating with centra; parapophyses beginning on centrum 6 or 7.

Description: In addition to the diagnostic characters given above, the following characters are common to the known species and are not repeated in the species accounts. Rounded caudal fin free from dorsal and anal fins in most specimens; however, in a few the fins are joined at their bases. Rays of ventral fins thick proximally but tapering to filamentous tips which do not extend beyond level of posterior end of pectoral fin. Pectoral fin broad and fanlike and inserted vertically on a broad muscle pad.

Head posterior to eyes compressed. Snout slightly depressed. Posterior nostril in front of eye with raised, fleshy rim. Short, tubular anterior nostril at anterolateral corner of snout immediately above lip.

Species: I recognize two. *D. macrodon* has been known heretofore only from New South Wales. I have examined material from North Island, New Zealand as well. The two populations show some differences, and may prove taxonomically separable. *D. multiradiatus* has been known heretofore from Kangaroo Island and the Great Australian Bight. The specimens from near Perth identified by Mees (1960) as *Dermatopsis caecus* (Waite) are both *D. caecus* and *D. multiradiatus*. The Western Australian and South Australian populations of *D. multiradiatus* may be separable.

Dermatopsis macrodon Ogilby

Figs. 1A, 2A, 2B, 3

Dermatopsis macrodon Ogilby, 1896, p. 140 (orig. descr., Maroubra, New S. Wales, near Sydney).—Ogilby, 1897, p. 86 (descr., Maroubra).—Whitley, 1935, p. 239, Fig. 8 (descr., refs., 20 spec. in Australian Museum from vicinity of Sydney).—Thines, 1955, p. 42, 78 (brief descr., listed as blind).

Diagnosis: A *Dermatopsis* with 71 to 80 dorsal rays, 45 to 57 anal rays, 39 to 45 vertebrae, and depth at vent 4.5 to 6.9 in standard length.

Study material: AUSTRALIA, NEW SOUTH WALES, all from near Sydney: AM I.12658, 1 specimen, Maroubra; AM IA.697, 2, Cogee; AM IB.512, 1, Sandor River (under rock); AM IB.7338, 3, inside North Head near Quarantine Beach, Manley; AM IB.492, 1, Vaucluse. NEW ZEALAND, North Island, all from the Bay of Islands and deposited in ANSP; WAS-NZ 11 and 12, 1 specimen, N end of smaller island, just NW

of Urupukapuka Id.; WAS-NZ 5, 1, SE side above small island; WAS-NZ 1, 14 (2 removed for clearing and staining), S end Urupukapuka Id.

Description: Counts and measurements summarized in tables 1 to 5. Body moderately elongate, depth at vent 4.5 to 6.9 in standard length. Body depth greatest at dorsal fin origin, tapering gradually to tail. Greatest body width behind head. Predorsal distance 3 to 4 times in standard length. Anal fin base origin at, or posterior to, midpoint of body. Ventral fins originating posterior to symphysis of cleithra by distance about equal to interorbital space. Pectoral fin 6.2 to 7.9 in standard length, extending at most to point one-half distance from pectoral fin upper angle to anal fin origin.

Scales on body non-imbricate, widely scattered; buried beneath a mucous coat on most specimens; apparently lacking on specimens less than about 30 mm SL. Scales absent on head; however, 1 Australian specimen, I. 12658, with rounded, pitlike structures on head, which resemble empty scale pockets more posteriorly on body. In the original description of *D. macrodon*, Ogilby mentioned scattered scales on the head. Frank Talbot examined the holotype for me and was unable to find either scales or scale pockets on the head.

Eye small, 8 to 14 times in head length, sunk beneath the surface. Most specimens with clear space in skin over eye, about equal in diameter to part of lens protruding through iris; few specimens with clear space over eye larger; eye completely covered with translucent skin in some specimens.

Posterior region of maxillary slightly or not at all sheathed. Prominent toothlike structure projecting down from maxillary at about level of rear margin of eye.

Gill rakers on first gill arch short, stubby, spiny tubercles; 3 or 4 longest on lower arm near angle; anteriorly along gill arch rakers are represented only by spiny bumps.

Premaxillary with band of short, sharply pointed teeth; band extending posteriorly to below eye; several longer teeth near anterior end of premaxillary. Vomer bearing V-shaped patch of unequal sized teeth. Similar teeth on palatines. Dentary bearing broad patch of small teeth anteriorly, similar to premaxillary teeth; extending posteriorly from each patch a single line of widely spaced large teeth interspaced with smaller teeth. No sexual dimorphism in dentition. Small specimens have notably fewer teeth than do large specimens; however, the general pattern of tooth distribution is similar in large and small fish.

The male genitalia (Fig. 2 B) consist of a fleshy hood, a curved papilla or penis which has fleshy, glandular (?) tissue attached to it, and two hard recurved claspers which extend posteriorly and at their distal ends turn laterally or posterolaterally. The claspers are flattened elongate structures. Sizes of papillae and claspers vary considerably; however, the claspers of specimen no. IB 7338 (Australia) are atypical and warrant special comment. They are large, flattened structures which

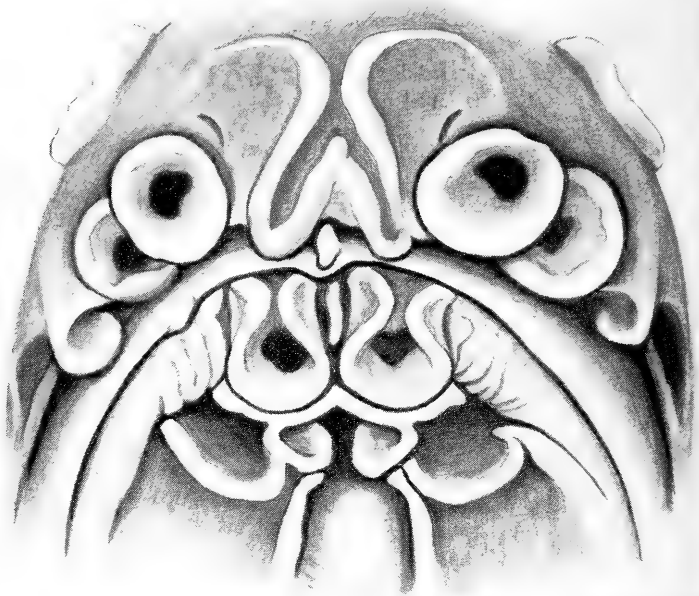


FIG. 3. *Dermatopsis macrodon*. AM IB 492 (see text for data). Anterior view of snout, slightly elevated, showing position of skin folds, pores, and nostrils. Drawn by Mildred H. Carrington.

project posteriorly and then dorsally beyond the margin of the genital hood. This specimen seems to be a typical *D. macrodon* in other respects, and I assume that its claspers are anomalous.

The distribution of lateralis system pores on the head (Fig. 3) is similar in Australian and New Zealand specimens. The lateral canal has a single pore near the upper angle of the gill opening. The supra-orbital canal has 2 to 3 pores; one on the edge of the upper lip in front of the anterior nostril, a second, higher on the snout, on the inner edge of a circular ridge of skin surrounding an area of very thin skin, and a third, quite small and not always visible, above and behind the eye. The suborbital canal has 5 pores, 3 in the convoluted skin along the upper lip on the snout, and 2 along the skin over the maxillary behind the level of the eye. The preoperculo-mandibular canal has 7 or 8 pores, 3 in the convoluted skin folds near the lower jaw tip, the others evenly spaced along the inner margin of the ramus of the dentary and the preopercle; the last pore position in the series usually bears 2 pores, sometimes 1. Minute lateral line organs are visible along the sides of only a few specimens. They are in the form of a row of delicate

papillae which originate near the upper angle of the gill slit. The lateral line extends posteriorly above the midline of the body as a row of about a dozen papillae. It descends to the midline slightly posterior to the level of the adpressed pectoral fin and extends to the caudal base as a row of another dozen papillae.

Vertebrae 1 to 5 have ribs articulating with the centra; those on 3 to 5 are pleural ribs; ribs on centrum 3, and to a lesser degree, on 4 are proximally flattened and bladelike; centra 6 to 13 have pleural ribs at ends of parapophyses. Epipleurals associated with pleural ribs on vertebrae 3, 4, 5, and sometimes 6. Thirteen abdominal vertebrae. Ribs on first 2 centra directed posteriorly, unlike pleural ribs on subsequent centra, which are directed ventrally or posteroventrally. The distal ends of the first 2 ribs are in line with the epipleurals of the following ribs. The two sides of the first neural spine are not fused. The above description is based on two cleared and stained specimens, one male and one female, from WAS-NZ 1, and on radiographs of all specimens.

All of the New Zealand specimens are uniformly pale. Some of the Australian specimens are pale anteriorly and dark brown posteriorly. Many specimens are covered with a thick mucous coating which contains many small granules.

Variation: *D. macrodon* is now known from New Zealand as well as New South Wales. It is to be expected that two populations of a shallow water species separated by 1200 miles of open water will show some morphological differences. Although my material is limited, I find three such differences: (1) Vertebral count—Australian range 39–42, New Zealand range 42–45. See table 5 for frequency distribution. (2) Body depth at vent—8 Australian specimens 30.0 to 57.9 mm SL, body depth ranges from 14.5 to 17.6 percent SL (average 16.3 percent); 8 New Zealand specimens 34.2 to 55.8 mm SL, body depth ranges from 16.7 to 22.3 percent SL (average 18.2 percent); (3) A characteristic feature of most New Zealand specimens, regardless of sex, is the presence of a pronounced rise in the dorsal profile between the rear of the head and the dorsal fin origin (Fig. 2 A). Most Australian specimens have only a gentle upward slope in this region.

Dermatopsis multiradiatus McCulloch and Waite

Figs. 4A, 4B

Dermatopsis multiradiatus McCulloch and Waite, 1918, p. 63, pl. 5, Fig. 4 (orig. descr., Kangaroo Id.).—Hubbs, 1938, p. 289 (discussion).—Scott, 1962, p. 172, Fig. (descr., Kangaroo Id., Cape Jervis).—Mees, 1962, p. 27 (head of Great Australian Bight).

?*Dipulus caecus* Waite, Thines, 1960, p. 45, pl. 1 (discussion of eye).

Dermatopsis caecus (Waite) in part, Mees, 1962, p. 27 (Rottnest Id.; Pt. Quobba, N of Shark Bay, Western Australia).

Diagnosis: A *Dermatopsis* with 98 to 114 dorsal rays, 64 to 72 anal

rays, 51 to 55 vertebrae, and depth at vent 8.5 to 11.4 times in standard length.

Study material: AUSTRALIA, WESTERN AUSTRALIA, Rottnest Island, east end of Nancy Cove, WAM P.12712-P.12736, 23 specimens; SOUTH AUSTRALIA, Head of Bight, S of Nullarbor, WAM P.4461, 3 specimens.

Description: Counts and measurements summarized in tables 1 to 5. Body elongate, depth at vent 8.5 to 11.4 times in standard length. Body depth greatest along trunk, between nape and vent, tapering gradually from level of vent to caudal peduncle. Greatest body width behind head. Predorsal distance 4 to 5 times in standard length. Anal fin base origin near midpoint of body. Ventral fins originating posterior to symphysis of cleithra by distance slightly less than interorbital width. Pectoral fin 8.5 to 12.7 in standard length, extending one-third to one-fourth distance from pectoral fin upper angle to anal fin origin.

Scales generally non-imbricate, not widely scattered, hidden beneath thick mucous coating and finely punctulate epidermal layer. It is necessary to scrape away congealed mucus and use a compressed air jet on the cleared area before scales can be seen. Scales lacking on head.

Eye small, 10 to 18 times in head length, sunk beneath the surface; eye visible through clear place in skin. In South Australian specimens the lens is opaque white whereas in Western Australian examples it is translucent blue. It seems likely that difference in color is related to preservative as each collection also contains a specimen of *Dinematichthys* with lenses colored like the *Dermatopsis* in the same collection. Thines (1960) studied the eye of a fish which he called *Dipulus caecus* and which may be identical with the species here discussed. He noted that the eye of this fish represents an example of "simple microphtalmy" [sic] rather than true regression.

Dorsal rim of maxillary free at its distal extremity, elsewhere sheathed. There is a blunt, toothlike, ventral projection from the maxillary at about the level of the rear margin of the eye.

Gill rakers low, spiny tubercles, as many as 6 or 7 along lower arm of first gill arch.

Premaxillary with band of short, sharply pointed teeth; band extending posteriorly to beneath posterior nostril. Vomer with triangular patch of teeth similar to premaxillary teeth; in some specimens a few larger teeth present. A band of similar teeth present on palatine. Dentary bearing anteriorly a granular patch of smaller teeth. On inner edge and extending posteriorly from this patch a single line of larger, conical teeth. No sexual dimorphism in dentition.

Male genitalia (Fig. 4 B) consisting of a fleshy hood, a papilla with a strongly recurved tip, which has fleshy, glandular (?) tissue attached to it, and two hard recurved claspers which turn laterally at almost right angles.

Lateral canal with a single pore near the upper angle of the gill opening. Supraorbital canal with 2 pores in the specimen from Western Australia and 3 in South Australian specimens. Fishes from both

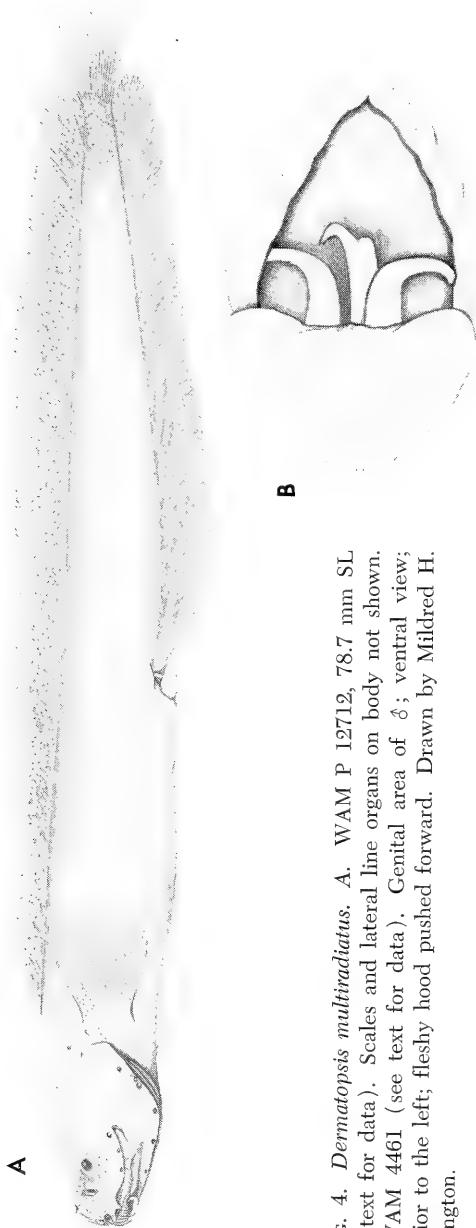


FIG. 4. *Dermatopsis multiradiatus*. A. WAM P 12712, 78.7 mm SL (see text for data). Scales and lateral line organs on body not shown. B. WAM 4461 (see text for data). Genital area of ♂; ventral view; anterior to the left; fleshy hood pushed forward. Drawn by Mildred H. Carrington.

localities have a pore in the flesh of the upper lip medial to the anterior nostril, and another behind the tube of the anterior nostril on the margin of a semicircular ridge of skin surrounding an area of very thin skin. A third pore of this series, present only in the South Australian specimens, is above and behind the eye. The suborbital canal has 6 pores, 3 in the convoluted skin along the upper lip on the snout and 3 along the skin over the maxillary behind the level of the anterior margin of the eye. The preoperculo-mandibular canal has 9 pores, 3 in the convoluted folds of skin near the lower jaw tip and the others along the inner margin of the ramus of the dentary and the preopercle; pores number 7 and 8 immediately adjacent to each other. The lateral line system along the side of the body is visible in a few specimens only. It consists of an upper section of about a dozen delicate papillae extending posteriorly from near the upper angle of the gill slit to about two-thirds the distance from the rear of the head to the vent, and a lower section of 25 to 30 papillae extending from the level of the termination of the upper line to the caudal fin base.

Vertebrae 1 to 5 have ribs articulating with the centra (based on radiographs). Subsequent abdominal centra have parapophyses, many of which bear ribs. The ribs are slight structures and do not show well on radiographs, and I cannot say whether they are present at the ends of all parapophyses. The two sides of the first neural spine are not fused.

The color is orange-brown; the South Australian specimens are slightly paler. A thick mucous coating, in which is embedded small orange granules, covers both the body and head. Beneath the mucous coating are numerous small, dark chromatophores which are externally visible only near the caudal fin base and along the dorsal fin base.

Variation: Mees (1962) referred South Australian and Western Australian material to different species, although he suggested they might represent subspecies rather than species. He listed three differences between the populations: degree of squamation and relative body depth (both of which I have been unable to verify) and color—possibly a function of preservation. The previously noted presence of a pore above and behind the eye in the South Australian specimens and its absence in the Western Australian material is the only character I have found which separates the material examined. As I have only three specimens in my South Australian sample, I prefer to consider the two populations conspecific.

Genus *Dermatopsoides*

Dermatopsoides Smith, 1947, p. 361 (type-species by original designation *Dermatopsis kasougae* Smith, 1943).

Diagnosis: Chin barbel absent. Gill membranes attached anteriorly to isthmus. Livebearing; male genitalia consisting of fleshy hood, two rounded, recurved, ossified claspers directed dorsally at their distal ends, and a penis. Pelvic fins immediately adjacent to each other, each with

single ray, fins not originating immediately behind symphysis of cleithra but placed about an interorbital distance behind. Caudal fin with 16 or more rays, not joined with dorsal and anal fins although in some specimens short membranes may reach between bases of dorsal and anal fins and caudal fin; pectoral fin entire, without separate, elongated rays. Scales lacking or widely scattered on head and non-imbricate or absent on body. No spine on opercle. Anterior nostril tubular, located directly above upper lip; gill rakers reduced. Branchiostegal rays 6. Lateral line consisting of very small dermal papillae (difficult to see in some specimens). Teeth present on premaxillary, vomer, palatine, and dentary; maxillary elongated posteriorly but not vertically expanded, sheathed in a fold of skin distally. Eyes small. Peritoneum pale.

First neural spine shortest; neural spines on abdominal centra with sharp tips. Vertebrae 1 through 5 or 6 with ribs articulating with centra; parapophyses beginning on centrum 6 or 7.

Species: Two species are known, both from South Africa. One is herein described for the first time. The distribution of these species falls within the region which Stephenson (1947, Fig. 2) assigned to the warm temperate Cape fauna; more specifically, they are probably part of his south coast (Stephenson, 1947, pl. 16) component. Smith (1946, Fig. 1) showed the distribution of South African clinids, and his list included four species with an even wider distribution than *D. talboti*.

***Dermatopsoides talboti*, new species**

Figs. 5A, 5B

Dermatopsoides kasougae Smith, 1949, p. 361, in part (brief description, Port Alfred to Bushman's River, Cape; *D. kasougae* is known only from the holotype; other specimens are *D. talboti*).

Diagnosis: A species of *Dermatopsoides* with no scales, 59 to 80 dorsal fin rays, 36 to 54 anal fin rays, and 17 to 18 pectoral fin rays. The eye goes into head length more than 15 times and the pelvic fin is no more than half the head length and does not extend beyond the posterior end of the pectoral fin.

Study material: SOUTH AFRICA, holotype, RU B. 59, ♂, 40.4 mm SL, Bird Island, Algoa Bay. Paratypes, RU B. 59, 1 spec., data as for holotype; SAM 21800, 1 spec., Somerset Strand, False Bay; USNM 199732, 1 spec., Simonstown, False Bay; SAM 21493, 1 spec., Saldanha Bay; SAM 21693, 1 spec., no data.

Description: Counts and measurements in tables 1 to 5. Body moderately elongate, depth at vent 5.8 to 8.3 in SL. Body depth about equal from level of nape to level of vent, tapering to tail. Greatest body width in region of belly between nape and vent, tapering thence to tail.

Dorsal fin origin on anterior third of body; anal fin origin posterior to midpoint of body. Vertical fins of some specimens covered with translucent skin, individual fin rays not easily visible; on other specimens skin

over fins clear. Dorsal and anal fins not continuously connected with caudal fin along their entire heights; however, membranes may be present at bases of last dorsal and anal rays connecting them with the caudal peduncle, or in some fish, with bases of dorsal and ventral rays of caudal fin. Caudal fin rounded. The single ray of each pelvic fin thick proximally, but tapering to filamentous tips which do not extend beyond level of posterior end of pectoral fin; pelvic fins originating posterior to symphysis of cleithra by a distance about equal to inter-orbital space. Pectoral fins inserted vertically on broad muscle pad; fins 6.4 to 8.1 in SL, extending about one-half of distance from pectoral fin upper angle to vent.

Eye tiny, skin-covered, sunk beneath surface of head, 16 to 30 times in head. A chromatophore-free porthole, in some specimens transparent, in others translucent, covering eye.

Head compressed, deeper than wide. Posterior nostril in front of eye, with raised, fleshy rim; short, tubular anterior nostril at anterolateral corner of snout immediately above lip.

Maxillary elongated posteriorly, not vertically expanded; posterior projection almost completely sheathed. The crease between snout and upper jaw interrupted by a broad frenum connecting suborbital area with anterior part of maxillary.

Gill rakers short, stubby tubercles, 3 or 4 on the upper arm of first arch and as many as 8 or 9 on lower. Tubercles progressively smaller anteriorly on each arm.

Premaxillary bearing short, pointed teeth which extend posteriorly in a line reaching only to level of anterior margin of eye. Cluster of similar teeth present at symphysis of dentaries; row of 8 to 10 larger pointed teeth extending posteriorly along dentary. Vomer with broadly V-shaped band of about 10 pointed teeth; about 8 or 9 similar teeth extending posteriorly in single row along palatines. No sexual dimorphism in dentition.

Male genitalia (Fig. 5 B) consisting of a fleshy hood; an elongate papilla or penis which has fleshy, glandular (?) tissue attached to it; and two hard, recurved claspers. The claspers extend posteriorly and turn dorsally at their distal ends.

The lateralis system is difficult to see, and only a few observations were possible. The lateral canal has a single pore, near the upper angle of the gill opening; the supraorbital canal apparently has a single pore, on the snout near the anterior nostril; the infraorbital canal has at least 5 pores, including 2 very large ones on the snout; and the preoperculo-mandibular canal appears to have at least 6 or 7 pores, including some very large ones with fleshy, convolute margins near the lower jaw tip. Small and inconspicuous papillae mark the course of the lateral line along the body. The line originates near the upper angle of the opercle and descends to the midline of the body between the level of the posterior end of the pectoral fin and the level of the vent. One speci-

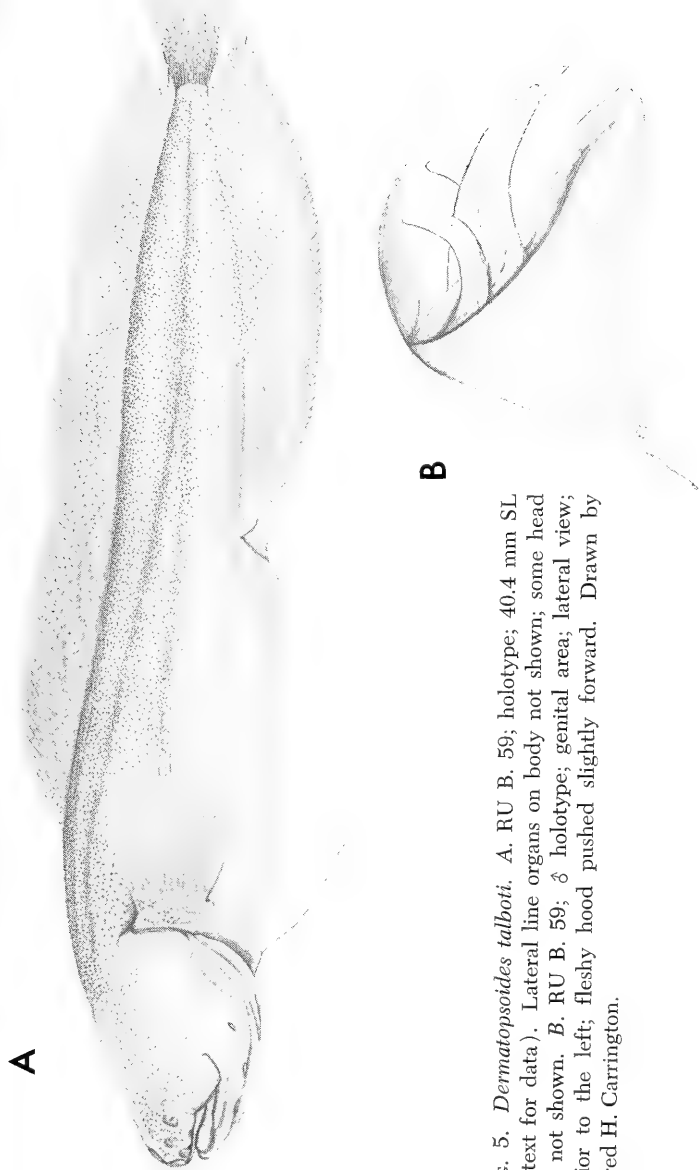


FIG. 5. *Dermatopsoides talboti*. A. RU B. 59; holotype; 40.4 mm SL (see text for data). Lateral line organs on body not shown; some head pores not shown. B. RU B. 59; ♂ holotype; genital area; lateral view; anterior to the left; fleshy hood pushed slightly forward. Drawn by Mildred H. Carrington.

men had about 20–25 papillae, another had 23. Papillae were not visible in the other specimens.

Vertebrae 1 to 5 have ribs articulating with the centra; 6 to 10, 11, or 12 have pleural ribs at the ends of parapophyses. Epipleurals are associated with at least some ribs; however, precise observations were not possible from radiographs.

Preserved specimens are pale. Small, dark chromatophores are distributed along the dorsal part of the head and trunk and on the side of the body behind the level of the vent. An entry in the fish catalog of the South African Museum noted that specimen number 23256 was "red in color."

Variation: The considerable meristic variation among specimens from widely separated localities suggests that when additional material is available subspecies may be demonstrable. The two specimens from Bird Island (at the east end of Algoa Bay) are geographically closer to the known locality for *D. kasougae*. However, they are meristically quite widely separated from it, while the west coast Saldanha Bay specimen of *D. talboti*, which is geographically farthest from the type-locality of *D. kasougae*, is closest to it in counts.

Dermatopsoides kasougae (Smith)

Dermatopsis kasougae Smith, 1943, p. 72, Fig. 3 (orig. descr.).

Dermatopsoides kasougae Smith, 1947, p. 344 (new genus proposed).—

Smith, 1949, p. 361, in part (brief descr., Port Alfred to Bushman's River, Cape; *D. kasougae* is known only from the holotype, the other specimens mentioned are *D. talboti*).

Diagnosis: A species of *Dermatopsoides* with non-imbricate scales on body, 100 dorsal fin rays, 71 anal fin rays, and 24 pectoral fin rays. The eye goes about 10 times in head length, and the pelvic fin is more than half the head length and extends beyond the posterior end of the pectoral fin.

Study material: The holotype, a male, from the mouth of the Kasouga River, west of Port Alfred.

Description: Counts and measurements in tables 1 to 5. The single known specimen is in poor condition, and I can add only a few items to the original description.

Although not shown in the original figure of the holotype, there are, as Smith noted in his written description, membranes connecting the bases of the posteriormost dorsal fin ray with the dorsalmost caudal fin ray and the posteriormost anal fin ray with the ventralmost caudal fin ray. Smith described the distribution of scales as follows, "The head is entirely naked. Minute very indistinct cycloid scales buried in a thick dermal layer over the whole body to the nape. It is only on the nape that they appear to be slightly diffuse, but as far as may be observed, on the rest of the body they are normally and regularly imbricate." I have examined the squamation using a compressed air jet, and I find the scales everywhere non-imbricate. They are more widely scattered

and more deeply embedded on the nape. C. Dawson examined the holotype and pointed out to me structures in the interorbital area which he believes to be scales or scale pockets. On the basis of the condition in this single specimen I prefer not to comment on whether the head has scales. Vertebrae 45.

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TABLE 1. Summary of proportional measurements on dermatopsine fishes.

| | <i>Dermatopsis macrodon</i> | | | | <i>Dermatopsis multiradiatus</i> | | | | <i>Dermatopsoides</i> | | | |
|--------------------|-----------------------------|-------------|----------|----------|----------------------------------|-----------|-----------|-----------|-----------------------|--------|---|---|
| | Australia | New Zealand | S. Aust. | W. Aust. | kasoungae | talboti | | | | | | |
| | Range% | Range% | N | % | Range% | % | Range% | N | % | Range% | N | % |
| Standard length | 30.0-68.5 | 25.1-55.9 | 8 | 74.9 | 52.0-95.8 | 63.3 | 26.6-50.9 | | | | | |
| Head length | 22.6 | 21.2-25.3 | 8 | 16.3 | 17.4 | 15.9-20.2 | 23.3 | 22.0-26.7 | | | | |
| Eye diameter | 2.2 | 1.7-2.7 | 7 | 1.1 | 1.2 | 1.0-1.6 | 1.1 | 0.74-1.4 | | | | |
| Snout length | 5.5 | 4.7-7.0 | 7 | 4.1 | 3.5 | 2.8-4.1 | 5.0 | 4.3-5.3 | | | | |
| Postorbital length | 15.9 | 15.1-17.3 | 7 | 10.3 | 12.0 | 10.5-13.4 | 16.4 | 14.7-17.8 | | | | |
| Predorsal length | 29.2 | 27.9-31.0 | 6 | 21.4 | 22.6 | 20.3-24.9 | 31.0 | 28.5-33.1 | | | | |
| Preal length | 53.6 | 50.6-55.8 | 8 | 53.0 | 51.4 | 48.1-54.0 | 55.2 | 52.2-59.5 | | | | |
| Preventral length | 18.5 | 17.4-20.4 | 7 | 13.8 | 13.8 | 12.3-15.2 | 19.2 | 17.1-21.8 | | | | |
| Body depth | 16.4 | 14.5-17.6 | 7 | 11.3 | 10.2 | 8.8-11.7 | 14.6 | 12.0-17.2 | | | | |
| Pectoral length | 13.5 | 11.2-16.3 | 6 | 8.3 | 9.4 | 7.9-11.3 | 15 | 12.4-15.3 | | | | |
| Ventral fin length | 12.9 | 11.2-16.0 | 7 | 7.9 | 10.0 | 7.5-14.1 | 15 | 7.9-13.4 | | | | |

TABLE 2. Frequency distribution of dorsal fin ray counts in dermatopsine fishes.

| | <i>Dermatopsis macrodon</i> | | <i>Dermatopsis multiradiatus</i> | | <i>Dermatopsoides</i> | |
|-------------|-----------------------------|----------------|----------------------------------|-------------------|-----------------------|--------------|
| | Aus- tralia | New Zealand | S. Aus- tralia | W. Aus- tralia | kas- ougae | tal- boti |
| Dorsal rays | | | | | | |
| 59 | | | | | | 1 |
| 60 | | | | | | 1 |
| 61 | | | | | | |
| 62 | | | | | | |
| 63 | | | | | | |
| 64 | | | | | | 1 |
| 65 | | | | | | 1 |
| 66 | | | | | | |
| 67 | | | | | | 1 |
| 68 | | | | | | |
| 69 | | | | | | |
| 70 | | | | | | |
| 71 | 2 | | | | | |
| 72 | | | | | | |
| 73 | 1 | | | | | |
| 74 | | 2 | | | | |
| 75 | 2 | 2 | | | | |
| 76 | | 3 | | | | |
| 77 | 1 | | | | | |
| 78 | | 1 | | | | |
| 79 | | 2 | | | | |
| 80 | 1 | 2 | | | | 1 |
| 98 | | | | 1 | | |
| 99 | | | | | | |
| 100 | | | | | 1 | |
| 101 | | | | | | |
| 102 | | | | | | |
| 103 | | | | | | |
| 104 | | | | 2 | | |
| 105 | | | 1 | 2 | | |
| 106 | | | 1 | 2 | | |
| 107 | | | | 3 | | |
| 108 | | | | 1 | | |
| 109 | | | | 2 | | |
| 110 | | | | 1 | | |
| 111 | | | 1 | | | |
| 112 | | | | | | |
| 113 | | | | | | |
| 114 | | | | 1 | | |

TABLE 3. Frequency distribution of anal fin ray counts in dermatopsine fishes.

| | <i>Dermatopsis macrodon</i> | | <i>Dermatopsis multiradiatus</i> | | <i>Dermatopsoides</i> | |
|-----------|-----------------------------|----------------|----------------------------------|-------------------|-----------------------|--------------|
| | Aus- tralia | New Zealand | S. Aus- tralia | W. Aus- tralia | kas- ougae | tal- boti |
| Anal rays | | | | | | |
| 36 | | | | | | 1 |
| 37 | | | | | | |
| 38 | | | | | | |
| 39 | | | | | | |
| 40 | | | | | | |
| 41 | | | | | | |
| 42 | | | | | | 1 |
| 43 | | | | | | |
| 44 | | | | | | 3 |
| 45 | 1 | | | | | |
| 46 | | | | | | |
| 47 | | | | | | |
| 48 | | | | | | |
| 49 | 2 | | | | | |
| 50 | 1 | 1 | | | | |
| 51 | 1 | 2 | | | | |
| 52 | 1 | | | | | |
| 53 | 1 | 3 | | | | |
| 54 | | 1 | | | | 1 |
| 55 | | 3 | | | | |
| 56 | 1 | | | | | |
| 57 | | 2 | | | | |
| 58 | | | | | | |
| 59 | | | | | | |
| 60 | | | | | | |
| 61 | | | | | | |
| 62 | | | | | | |
| 63 | | | | | | |
| 64 | | | 1 | 1 | | |
| 65 | | | 1 | | | |
| 66 | | | 1 | | | |
| 67 | | | | 1 | | |
| 68 | | | | 3 | | |
| 69 | | | | 3 | | |
| 70 | | | | 3 | | |
| 71 | | | | 3 | 1 | |
| 72 | | | | 2 | | |

TABLE 4. Frequency distribution of pectoral fin ray counts in dermatopsine fishes.

| | <i>Dermatopsis macrodon</i> | | <i>Dermatopsis multiradiatus</i> | | <i>Dermatopsoides</i> | |
|---------------|-----------------------------|----------------|----------------------------------|-------------------|-----------------------|--------------|
| | Aus- tralia | New Zealand | S. Aus- tralia | W. Aus- tralia | kas- ougae | tal- boti |
| Pectoral rays | | | | | | |
| 17 | | | | | | 5 |
| 18 | | | | | | 1 |
| 19 | | 4 | | 1 | | |
| 20 | 1 | 4 | 2 | 1 | | |
| 21 | 4 | 4 | | 5 | | |
| 22 | 1 | | | 12 | | |
| 23 | 1 | | | 2 | | |
| 24 | | | | | 1 | |

TABLE 5. Frequency distribution of vertebrae in dermatopsine fishes.

| | <i>Dermatopsis macrodon</i> | | <i>Dermatopsis multiradiatus</i> | | <i>Dermatopsoides</i> | |
|-----------|-----------------------------|----------------|----------------------------------|-------------------|-----------------------|--------------|
| | Aus- tralia | New Zealand | S. Aus- tralia | W. Aus- tralia | kas- ougae | tal- boti |
| Vertebrae | | | | | | |
| 37 | | | | | | 1 |
| 38 | | | | | | 1 |
| 39 | 1 | | | | | 3 |
| 40 | 1 | | | | | |
| 41 | 3 | | | | | |
| 42 | 3 | 2 | | | | |
| 43 | | 10 | | | | 1 |
| 44 | | | | | | |
| 45 | | 2 | | | 1 | |
| 46 | | | | | | |
| 47 | | | | | | |
| 48 | | | | | | |
| 49 | | | | | | |
| 50 | | | | | | |
| 51 | | | 1 | | | |
| 52 | | | | | | |
| 53 | | | 1 | 6 | | |
| 54 | | | 1 | 7 | | |
| 55 | | | | 4 | | |

PROCEEDINGS
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GUNTERICHTHYS LONGIPENIS, A NEW GENUS AND
SPECIES OF OPHIDIROID FISH FROM THE
NORTHERN GULF OF MEXICO

BY C. E. DAWSON

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Since 1963 I have received five collections of a small undescribed ophidioid fish, referable to the tribe Dermatopsini (Cohen, 1966), from Mississippi Sound and adjacent waters. The collections were provided by Mr. J. Y. Christmas, members of the Gulf Coast Research Laboratory larval shrimp project, Mr. Bruce Hensen, and Mrs. Josephine G. Curtis.

Dr. David Caldwell, Los Angeles County Museum, and Messrs. Robert Ingle and Martin Moe, Florida State Board of Conservation, kindly loaned comparative material from collections in their care. My appreciation is expressed to Dr. E. A. Lachner and his staff for many courtesies extended during my visits to the Division of Fishes of the United States National Museum and to Dr. William Gosline for his comments on the manuscript. Special acknowledgment is due Dr. Daniel M. Cohen for permitting examination of type-material in his care, for allowing me to consult his (then unpublished) MS on the tribe Dermatopsini and for his interest and assistance in this study.

The type-material has been deposited in the collections of the United States National Museum (USNM) and the Gulf Coast Research Laboratory (GCRL).

GUNTERICHTHYS, new genus

Type-species: Gunterichthys longipenis new species.

Diagnosis: An ophidioid fish with dorsal and anal fins separate from caudal; ventral fins of one ray each, inserted posterior to cleithral symphysis and approximately below middle of opercle. Eyes small, distinct and covered with skin; posterior naris subequal to or larger than eye, and with slightly elevated margin; chin barbel absent. Preopercular margin

not free, but delineated by dermal fold; preopercle with single slitlike pore at angle; opercle with single, slender, weak spine. Head scaleless but microscopically papillose; body scales barely overlapping; vertical fins, pelvic and pectoral fin bases scaleless. Gill openings broad, lateral; gill membranes free from isthmus. Developed gill rakers both above and below first gill arch angle. Maxillary not vertically expanded behind and not completely concealed by a dermal fold of the cheek. Vomer with enlarged depressible teeth; palatine teeth enlarged; maxillary teeth mainly villiform; lateral mandibular teeth, in part, enlarged, depressible and caniniform. Lacking pyloric caecae and pseudobranchiae; lateral line inconspicuous. Body compressed, gradually tapering posteriorly, dorsal and ventral margins slightly convex. Caudal fin long, narrow and pointed; with 13–14 rays. Male with long, pointed, distally hardened intromittent organ, and one pair of broad, hardened claspers. Dermal envelope of anal fin, in both sexes, very loose near anal origin, continuing forward as a fold on either side of genital apertures to form a protected scoop-like enclosure. Presumably viviparous.

Relationships: The scaleless head, the barely overlapping body scales, the presence of a single pair of hard genital claspers and the absence of vertical expansion of the posterior maxillary places *Gunterichthys* in the tribe Dermatopsini (Cohen, *op. cit.*). It differs from other included genera (*Dermatopsis* Ogilby, *Dermatopsoides* J. L. B. Smith and, tentatively, *Diancistrus* Ogilby) in having all gill membranes free from the isthmus, body scales slightly overlapping rather than non-imbricate or absent, a microscopically papillose head, fewer caudal rays, and in the specialized development of the genital enclosure.

I take pleasure in naming this genus after Dr. Gordon Gunter.

Remarks: Two genera of small viviparous ophidioid fishes with separate caudal fin and hard copulatory apparatus (*Ogilbia* Jordan and Evermann and *Dinematichthys* Bleeker) have been reported from shallow waters of the western north Atlantic Ocean. Although the status and systematics of these two genera are presently confused, both have at least partially scaled heads and are thereby separable from *Gunterichthys*.

***Gunterichthys longipenis*, new species**

(Fig. 1)

Holotype: USNM 199431; 45 mm in standard length (SL); male; on north shore of Davis Bayou, off Mississippi Sound, Mississippi (USCGS Chart 1267); 27 March 1965.

Paratypes: USNM 199757; 36 and 34 mm SL; male and female respectively; Mississippi Sound, on north shore of Horn Island, Mississippi, at Horseshoe; 4 December 1963. GCRL V64:1046; 39 mm SL; male; data as for USNM 199757. USNM 199430; 44 mm SL; male; apparently infected with lymphocystis disease; Mississippi Sound near east end of Ship Island, Mississippi; larval shrimp trawl, maximum depth 2 m; 6 March 1963. GCRL V66:1527; 38 mm SL; male; on



FIG. 1, *Gunterichthys longipenis*. USNM 199431; holotype; 45 mm SL. Lateral line organs, scales and head papillae not shown. Drawn by Mildred H. Carrington.

shore of Biloxi Back Bay, Mississippi; 10 February 1966. GCRL V64:1048; head and anterior body only; male; entrance to Davis Bayou, Mississippi; 3 January 1964. The latter specimen has been cleared and stained with alizarin.

Description: Body compressed, greatest depth just before dorsal origin; head depth and width subequal, slightly less than 1.5 in head length; body width almost twice in head width. Dorsal head profile curving gradually downward to the blunt and narrowly rounded snout; ventral profile rises even more gradually to the slightly included lower jaw. Skin covering head and fins and skin about genital apertures very loose. Snout length slightly less than interorbital width; interorbital broad, slightly convex, with suggestion of a median longitudinal ridge which appears to originate at snout and continue posteriorly to nape. Anterior naris large, tubiform, short, located near anterior margin of upper lip, slightly overhanging premaxillary; posterior naris close to eye, margins slightly elevated, diameter subequal to or greater than eye. Eye minute, averaging 18.5 in head, without free margins, covered with translucent skin devoid of melanophores over eye. All but posterior third of maxillary concealed by dermal fold of the cheek; posterior maxillary margin arcuate, lower angle scarcely produced, not spinelike.

Opercle with one slender, weak, pointed spine located some distance from opercular margin at the level of upper opercular angle; penetrating skin in two specimens. Preopercular margin indistinct, delineated only by low dermal fold.

Snout and fleshy suborbital developed as pronounced fold overhanging thin skirtlike upper lip which is somewhat produced medially. Slitlike pore, subequal in diameter to anterior naris, present on inferoanterior margin of snout between median symphysis and anterior naris; a second slit, with length approaching twice anterior naris diameter, extends along inferolateral snout margin from near posterior border of anterior naris to hind margin of posterior naris. This slit vertically bisected by a septum which is incomplete at base. Minute pore present slightly removed from suborbital margin above ventral angle of maxillary; another pore, about twice first pore diameter, similarly located near posterior angle of suborbital fold. Preopercular fold with single slitlike pore, subequal in diameter to eye, on inferior margin of lower angle. Slightly above middle of this pore, in line with rear end of maxillary, is a single, short, stout, sensory papilla. Similar papillae located dorsally on head; one behind each eye, six across interorbital, two on either side of midline of snout, and two, widely spaced, near upper margin of each naris; all are inconspicuous and difficult to see. Minute tubule and pore present on dorsolateral margin of head at about one-third of distance between interorbital and nape, closest to eye. A well-developed circular dermal fold present below lip on both sides of lower jaw symphysis; within each is a slitlike pore and a stout sensory papilla atop a short fleshy pedestal. Behind and inferior to these is an additional pair of large pores opening supralaterally within a subcircular fleshy

TABLE 1. Measurements (mm) and counts of *Gunterichthys longipennis*. Figures in parentheses are percentages of standard length or head length.

| | USNM 199431 Holotype | USNM 199757 Male | USNM 199757 Female | USNM 199430 | GCRL V64:1046 | GCRL V66:1527 | $\bar{X}\%$ |
|---|-------------------------|---------------------|-----------------------|----------------|------------------|------------------|-------------|
| Standard length | 45.0 | 35.5 | 34.4 | 43.9 | 39.2 | 37.5 | |
| Caudal fin length | — | | | | | | 18.0 |
| Least caudal peduncle depth | 1.9 (4.2) | 6.8 (19.2) | 6.2 (18.0) | 7.2 (16.4) | 7.3 (18.6) | — | 4.2 |
| Body depth at anal fin origin | 7.5 (16.7) | 1.6 (4.5) | 1.5 (4.4) | 1.9 (4.3) | 1.6 (4.1) | 1.5 (4.0) | 16.8 |
| Predorsal length | 15.1 (33.6) | 6.1 (17.2) | 6.1 (17.7) | 7.9 (18.0) | 6.2 (15.8) | 5.8 (15.5) | 34.7 |
| Prenal length | 25.1 (55.8) | 12.4 (34.9) | 12.9 (37.5) | 14.9 (33.9) | 13.4 (34.2) | 12.7 (33.9) | 55.2 |
| Pectoral fin length | 7.5 (16.7) | 19.7 (55.5) | 18.6 (54.1) | 24.1 (54.9) | 21.2 (54.1) | 21.2 (56.5) | 16.6 |
| Ventral fin length | 7.8 (17.3) | 5.9 (16.6) | 5.8 (16.9) | 7.4 (16.9) | 6.3 (16.1) | 6.1 (16.3) | 17.8 |
| Distance from ventral insertion to anal fin origin | | 6.4 (18.0) | 6.2 (18.0) | 8.1 (18.4) | 7.9 (20.2) | 5.5 (14.7) | |
| Snout tip to ventral fin insertion | 16.2 (36.0) | 11.5 (32.4) | 10.8 (31.4) | 15.2 (34.6) | 12.9 (32.9) | 13.5 (36.0) | 33.9 |
| Longest dorsal ray length | 9.4 (20.9) | 8.2 (23.1) | 8.1 (23.6) | 9.8 (22.3) | 7.9 (20.2) | 8.2 (21.9) | 22.0 |
| Longest anal ray length | 4.4 (9.8) | 3.6 (10.1) | 4.1 (11.9) | 4.7 (10.7) | — | 4.4 (11.7) | 10.8 |
| Head length | 4.4 (9.8) | 3.5 (9.9) | 4.1 (11.9) | 4.7 (10.7) | — | 4.0 (10.7) | 10.6 |
| Eye diameter | 11.5 (25.6) | 10.1 (28.4) | 10.0 (29.1) | 11.7 (26.5) | 11.1 (28.3) | 10.3 (27.4) | 27.6 |
| Snout length | 0.7 (6.0) ¹ | 0.5 (5.0) | 0.5 (5.0) | 0.7 (6.0) | 0.5 (4.5) | 0.6 (5.8) | 5.4 |
| Postorbital length | 2.3 (20.0) | 2.0 (19.8) | 2.0 (20.0) | 2.2 (18.8) | 2.1 (18.9) | 2.0 (19.4) | 19.5 |
| Snout tip to rear of maxillary fleshy interorbital width | 8.5 (73.9) | 7.6 (75.2) | 7.5 (75.0) | 8.8 (75.2) | 8.5 (76.6) | 7.7 (74.8) | 75.1 |
| Number of dorsal rays | 5.5 (47.8) | 4.0 (39.6) | 3.8 (38.0) | 5.4 (46.2) | 4.5 (40.5) | 3.9 (37.9) | 41.7 |
| Number of anal rays | 2.7 (23.5) | 2.0 (19.8) | 2.2 (22.0) | — | 2.1 (18.9) | 2.3 (22.3) | 21.3 |
| Number of caudal rays | 66 | 68 | 64 | 66 | 66 | 64 | |
| Number of right pectoral rays | 45 | 50 | 46 | 45 | 47 | 45 | |
| Number of left pectoral rays | 13 | 14 | 14 | 14 | 14 | 13 | |
| | 19 | 19 | 18 | 22 | 18 | 19 | |
| | 20 | 19 | 18 | 21 | — | 19 | |

¹ This and following proportions shown in percent of head length.

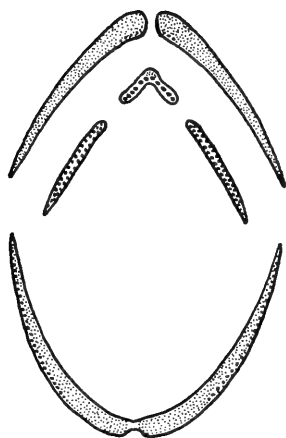
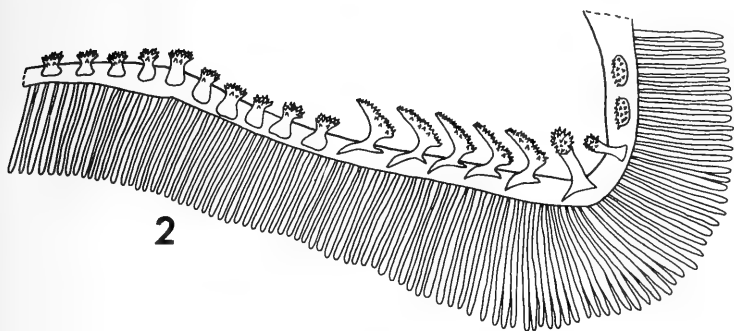
fold about the midline. Slitlike pore present on upper anterior mandibular margin just beneath lower lip; three subcircular pores with slightly elevated margins equally spaced along inner third of submandibular surface, the last near lower mandibular angle. Anterior submandibular surface with about six stout sensory papillae, with three or four others distributed posteriorly.

Cleithrum extends forward ventrally to a point about midway between lower preopercular angle and rear end of maxillary; in cleared material cleithrum extends almost to the level of maxillary. Gill arches four, with slit behind fourth. First arch gill rakers (Fig. 2), described from cleared paratype material, as follows: two oval dentigerous patches and one long clubshaped raker on epibranchial, then a longer, stouter, similarly shaped raker at angle followed, on ceratobranchial, by five rather long, broad, sickleshaped rakers and five smaller knoblike rakers. Hypobranchial bears five similar knoblike rakers; all rakers crowned by dentiform processes.

Premaxillary teeth (Fig. 3) predominately villiform and in several irregular series; inner teeth near symphysis increase some in size; these teeth depressible and slightly recurved. Vomer broadly V-shaped, bearing about eleven sharply pointed, depressible, conical teeth which increase in size outward from apex; several villiform teeth present at anterior apical margin. Palatines with smaller teeth, similar to those of vomer, in what appears to be two longitudinal series; some minute villiform teeth also present. Dentaries narrowly united but edentate at symphysis, anteriorly covered with villiform teeth but with inner row of rather larger, sharp and depressible, conical teeth. Laterally, there is a narrow outer series of villiform teeth and an inner series of about 25 or 30 large, depressible, caniniform teeth, somewhat recurved near tips. Three suprabranchial patches of villiform teeth located between 1st and 4th arches present on each side; these teeth closely approximated, middle patch the largest.

Dorsal fin originating over middle or anterior third of adpressed pectoral fin; low at origin with longest rays posteriorly; all rays branched except anteriormost which may (in four specimens) be simple. Anal fin origin somewhat closer to rear margin of hypural than to snout tip; rays branched, longest posteriorly. Dorsal and anal fins separate, not confluent with the long, narrow and pointed caudal fin. Pectoral fin inserted at slight angle, originating on moderate peduncle; narrowly rounded with all rays branched, none separate. Ventral fins, each a single ray with two hemitrichs, approximated at base and inserted below middle of opercle; somewhat longer than pectoral fins.

Scales small, cycloid; frequently separate, subcircular and embedded near anteroventral abdominal margin, otherwise barely overlapping and somewhat oval. Head, chest anterior to ventral insertion, pectoral axil and peduncle and all fins scaleless. Head with minute ciliated papillae; cilia colorless, the longest about 0.1 mm; most abundant dorsally, rather sparse on preopercle and apparently absent from snout tip and upper



FIGS. 2-3, *Gunterichthys longipenis*. 2, First gill arch. 3, Dentition. Author's semi-diagrammatic delineations from GCRL V64:1048, paratype.

lip. No thick mucous coating on head or body. Lateral line inconspicuous; evidently in two parts; delineated by rather widely spaced minute papillae. Midlateral series of papillae originating beneath upper third of pectoral fin and extending to near hypural; about 25 papillae over this distance. Second series of papillae originating near upper opercular angle and, passing about midway between median sensory line and dorsal fin insertion, extends at least as far posteriorly as 40th-41st dorsal fin ray.

In both sexes the anterior plane of the anal fin is broadly flattened basally and the dermal sheath continues forward on either side of the genital aperture (Fig. 1) as a loose fold to form a protective scooplike enclosure. In males, these folds join the posterior portion of a swollen muscular prominence containing the anus; in females, they join to form a loose fold surrounding the anus and the genital opening behind. Externally, the male copulatory apparatus consists of a single pair of broad, slightly retrorse claspers, a long, distally hardened, posteroventrally directed intromittent organ and a broadly pointed, muscular, posteriorly directed flap which, ventrally, protects these structures. The intromittent organ tapers narrowly to a point, lacks a fleshy (glandular) sheath, and is not beveled at the tip as described for *Dinematichthys iluocoeteoides* (Turner, 1946). The claspers angle outward at about 45° from the midline and the inner faces are posterodorsally concave, thus forming a broad groove. Stained material shows the claspers to consist of two ossified supports. The dorsal member is long, narrow and posteriorly both concave and truncate; the ventral is shorter and tapers posteriorly to a point. There is no sign of an "accessory cornified body" similar to that described by Turner (*op. cit.*).

Dissection of the damaged specimen revealed no sign of pyloric caecae.

Fin ray counts and proportional measurements expressed in millimeters and in percentage of standard length or head length are shown for six specimens of the type-series in Table 1. Vertebral counts, from radiographs of this same material, are $11-12 + 27-29 = 39-41$. The first neural spine is short and strong; second to fourth longer, the third almost reaching nape margin; fifth to seventh shorter and somewhat depressed; remainder progressively elevated and needlelike; neural spines of abdominal centra with sharp tips. Vertebrae one through five or six with ribs articulating with centra; parapophyses beginning on centra six or seven.

The following color notes were made from the holotype, in life: caudal dusky with a narrow colorless distal margin; anterior of dorsal fin flecked with several fine salmon bars on, or parallel to, the third to fifth dorsal rays; posterior half of dorsal fin and posterior three-quarters of anal fin dusky brown with a pale marginal band; body generally pale gold; eye with black pupil surrounded by a narrow iridescent silvery iris; posterior body translucent with vertebral centra distinctly visible through the distal two-thirds of its length; rose colored gill filaments visible through the opercle; ventral abdomen pale mauve, remainder of ventral surface pale pink; pectoral and ventral fins colorless.

In alcohol the body ground color is pale beige, that of dorsal and anal fins colorless or pale grey; pectoral and ventral fins beige. Eye black. Snout, suborbital and top of head closely speckled with tan to dark brown melanophores; a few near the mandibular symphysis, otherwise, lower jaw, branchiostegal membranes, preopercle and opercle without, or with but a few solitary melanophores. Ventrolateral body from below the

upper third of pectoral axil to near anterior third of anal fin devoid of melanophores; elsewhere body thickly punctate with some decrease in melanophore density ventrally. Posterior half of dorsal fin, caudal fin and most of anal fin densely punctate, resulting in a dark brown coloration; melanophore concentration reduced toward fin margins and bases. This general pattern is well defined in four specimens; in one there has been some fading but microscopic examination shows the described melanophore distribution.

Remarks: The living holotype showed undulatory movements of the vertical fins and body similar to those illustrated by Whitley (1935) for *Dermatopsis macrodon*. In addition, the fish would hang, apparently motionless, an inch or more from the bottom of the aquarium at an attitude of about 45° for considerable periods of time. No loose substrate was provided but general behavior patterns were in some respects (tail standing, etc.) similar to those reported for *Otophidium taylori* (Herald, 1953) and suggest a burrowing habit.

All known specimens of *Gunterichthys* were taken during or immediately after a period of unusual climatic conditions. Five of the paratypes were taken following exposure to abnormally low temperatures; the three Horn Island specimens were found dead in the swash; the damaged Davis Bayou fish was found floating at the surface, and the Ship Island specimen was trawled. These fish were presumably stunned or cold-killed, a common phenomenon in the Gulf of Mexico (Brongersma-Sanders, 1957). The holotype and remaining paratype were found stranded but alive following torrential rains accompanied by rapidly falling storm tides. Rainstorm induced mortality of *Branchiostoma* has been reported in Mississippi Sound (Dawson, 1965) and it is not improbable that *Gunterichthys* is similarly unable to tolerate rapid decrease in salinity. The type-localities have been heavily sampled with fine mesh seines and trawls for several years, particularly during summer months, yet no other specimens have been taken. Observed behavior, occurrence in connection with abnormal environmental conditions, absence from extensive conventional collections and the presence of very reduced eyes lend credence to the assumption that this is a burrowing or burrow inhabiting species. Substrates at and near the collection sites consist of sand, mud and various sand-mud mixtures.

The specific name refers to the exceptional development of the male intromittent organ.

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PROCEEDINGS
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A NEW GENUS IN THE CHILOPOD FAMILY DIGNATHODONTIDAE WITH PROPOSAL OF TWO
SUBFAMILIES

(CHILOPODA: GEOPHILOMORPHA)

BY RALPH V. CHAMBERLIN

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Graf Attems (1929) in his classic revision of the geophilid chilopods treats the dignathodontids as a subfamily, Dignathodontinae, of the family Geophilidae. He distinguishes this subfamily from the Geophilinae *sens. str.* as follows:

"Labrum in eine obere und untere Lamelle geteilt, die obere bildet das Mittelstück, dessen Zähne nach vorn gerichtet sind, die untere Lamelle bildet Seitenteile oder ist rudimentär. Körper vorn stark verjüngt. Kopf sehr klein." (Attems, *op. cit.*, in the key, p. 158).

Attems' statement in this diagnosis that the teeth of the middle piece of the labrum are directed forward should have been qualified by the fact that he includes in this subfamily the American genus *Agathothus* Bollman in which these teeth are directed caudad as shown in Fig. 1. More recently several other American genera having this characteristic of the labrum have been made known. To this list a new genus to bear the name *Horonia* is added in the present paper. For this group of genera, I here propose a new subfamily, Agathothinae with type-genus *Agathothus* Bollman. The remaining genera of the Dignathodontidae are retained in a subfamily Dignathodontinae *sens. str.* of which the type-genus is *Dignathodon*.

Up to the present the Agathothinae were known only from the Americas where they have been recorded chiefly from the southern United States and Mexico, with one genus, *Araucania*, reported from Argentina. The following key will aid in separating the presently known genera.

KEY TO GENERA OF THE AGATHOTHINAE

1. Pleurocoxal glands opening through two large pores on each side *Pagotaenia* Chamb.
 Pleurocoxal pores more numerous, small 2
2. Palpus of second maxillae lacking a true claw, ending in a tubercle *Malochora* Chamb.
 Palpus of second maxillae ending in a normal claw 3
3. Middle piece of labrum bearing a series of subconical teeth 4
 Middle piece of labrum bearing a fringe of sub-setiform teeth (fimbriae) 5
4. Claw of prehensors armed at base with a conical tooth; ventral pores in two separated areas on each sternite *Araucania* Chamb.
 Claw of prehensors not thus armed; ventral pores not in two areas on each sternite *Zantaenia* Chamb.
5. Syncoxite of first maxillae with a lappet on each anterior corner; lateral pieces of labrum covered by the median piece *Horonia*, new genus
 Syncoxite of first maxillae without such lappets; lateral pieces of labrum with only mesal ends overlapped by the median piece *Agathothus* Bollm.

***Horonia*, new genus**

Description: Head nearly as broad as long; lacking a frontal suture. Antennae long and filiform.

Labrum with middle piece large, extending entirely across the buccal cavity, its caudal margin bearing a fringe of slender, close-set fimbriae. First maxillae with syncoxite bearing a long lappet on each outer corner, telopodite biarticulate and lacking lappets, coxae of second maxillae weakly united at middle, the claw smooth.

Prehensors with claws when closed not extending appreciably beyond the front margin of the cephalic plate; prosternum unarmed anteriorly, with postcondylic sclerotic lines (raphes) complete; the tarsus and femuroid armed mesally.

The last sternite proportionately long and narrow. Pleurocoxal pores small and numerous, typically opening both ventrally and dorsally.

Anal pores present.

Type-species: *Horonia bella*, new species.

***Horonia bella*, new species**

Description: General color light orange. Body strongly attenuated caudad, more moderately cephalad; posterior part of body in the holotype depressed or flattened.

Cephalic plate scarcely longer than broad, of form shown in Fig. 2.

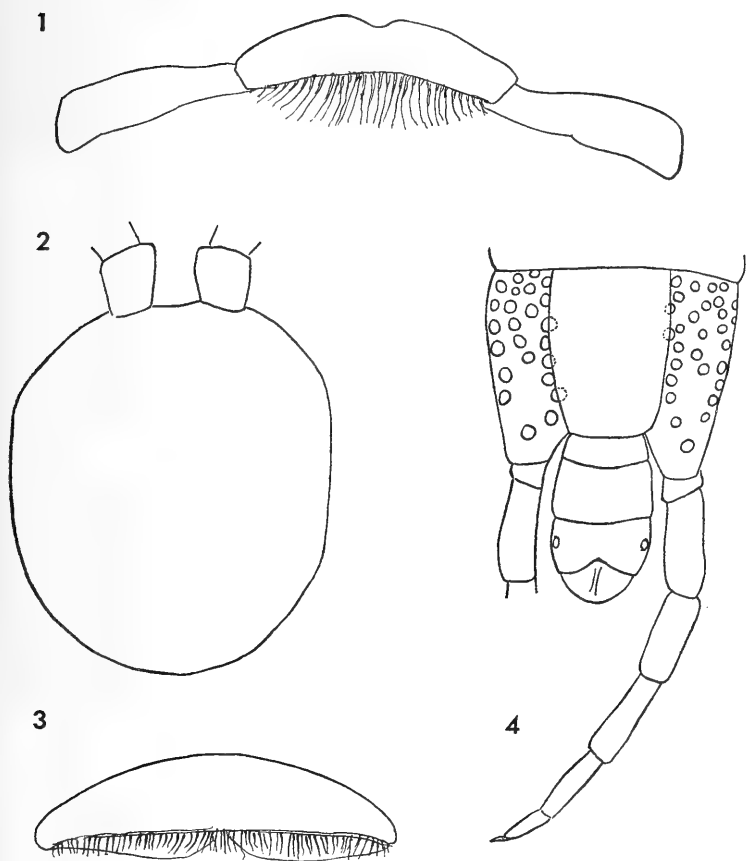


FIG. 1, *Agathothus gracilis* Bollman, labrum. Figs. 2-4, *Horonia bella*, new species. 2) head in outline, 3) labrum, 4) caudal end, ventral aspect.

Antennae long and filiform, their ultimate articles subconical and as long as the two articles preceding it taken together.

Median piece of labrum large, its posterior margin with a fringe or comb of rather short spiniform processes or teeth. Syncoxite of first maxillae bearing at each anterolateral corner a long, forwardly directed papillose lappet; palpus subconical, biarticulate and lacking exterior lappets. Coxae of second maxillae united at middle only by a narrow membranous isthmus which in part shows some polygonal areolae; behind this isthmus deeply notched or incised; claw of the palpus normal and smooth.

Basal plate trapeziform, short and broad. Prehensors a little exposed at sides of cephalic plate behind, its claws when closed scarcely or not at all surpassing that plate anteriorly. Prosternum not armed with teeth on anterior margin; sclerotic lines present and complete. A conical tooth present at base of claw and a similar one at distal end of the femuroid.

Anterior sternites each with caudal margin forming an obtuse angle, the apical portion of which projects into a cavity under the border of the succeeding sternite.

No ventral pores.

Last sternite proportionately long and narrow. Pleurocoxal pores small and independent, numerous and present both above and below (Fig. 3).

Anal pores present.

Pairs of legs, 49.

Length, 38–40 mm.

Locality: New Mexico, 13 mi. NE Bernabello. Two specimens collected 17 September 1946, by Stanley Mulaik.

The holotype and paratype at present retained in the Chamberlin collection at the University of Utah.

AGATHOTHUS Bollman

Agathothus Bollman, 1893, Bull. U. S. Nat. Mus. 46: 166.

———— Chamberlin, 1913, Bull. Mus. Comp. Zool., Harvard 54 (13): 428.

———— Attems, 1929, Das Tierreich 52: 231.

Type-species: *Scolioplanes gracilis* Bollman (Type by original designation and monotypy).

Type-locality: Tennessee.

PAGOTAENIA Chamberlin

Pagotaenia Chamberlin, 1915, Bull. Mus. Comp. Zool., Harvard 59: 508.

———— Attems, 1929, Das Tierreich 52: 241.

Type-species: *Pagotaenia lestes* Chamberlin (Type by original designation and monotypy).

Type-locality: Mexico, Hidalgo, Guerrero Mill.

ARAUCANIA Chamberlin

Araucania Chamberlin, 1954, Lunds Univ. Arsskrift, N.F., Avd. 2, 54 (5): 32.

Type-species: *Linotaenia araucanensis* Silvestri (Type by original designation and monotypy).

Type-locality: Chile, Los Muermos.

ZANTAENIA Chamberlin

Zantaenia Chamberlin, 1960, Proc. Biol. Soc. Washington 73: 240.

Type-species: *Zantaenia idahoana* Chamberlin (Type by original designation and monotypy).

Type-locality: Idaho, Wallace.

MALOCHORA Chamberlin

Malochora Chamberlin, 1941, Ann. Entomol. Soc. Amer. 34: 773.

Type-species: *Malochora linsdalei* Chamberlin (Type by original designation and monotypy).

Type-locality: California, Hastings Reservation.

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ATTEMS, CARL GRAF. 1929. Geophilomorpha. Das Tierreich, 52: 1-388.

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TWO NEW FAMILIES AND OTHER NORTH AMERICAN
DIPLOPODA OF THE SUBORDER CHORDEUMIDEA

By H. F. LOOMIS
Miami, Florida

The material on which this paper is based has been accumulating for many years. Following a recent examination of it, showing that two new families are involved, one typified by a recognized genus, the other undescribed, I thought it desirable to publish the information, as well as that concerning other species of the suborder represented in the collection. All specimens have been deposited in the U. S. National Museum.

Apterouridae, new family

Type-genus: *Apterourus*, new genus.

Diagnosis: Related to the Tingupidae but distinguished by the granular to smooth metazonites having large macrosetae; lateral keels not present beyond segment 24, thin, and nearly horizontal; gonopods formed from eighth legs only; ninth legs essentially like those that follow.

Description: Body small, strongly chitinated, and composed of 30 segments; macrosetae long and stout.

Head scarcely wider than segment 1 and not covered by it; antennae moderately short and crassate; ocelli in several series; gnathochilarium with a promentum.

Segment 1 nearly as wide as segment 2 and with projecting outer angles. Segments 2-24 with broad, thin, horizontally projecting lateral keels gradually reduced in size caudally and absent behind segment 24; keeled metazonites densely granular. Last segment rounded-truncate at apex, sides oblique. Anal valves squarely angular at dorsoposterior limit.

Gonopods formed from eighth pair of legs only, and with stout flagella. Ninth legs similar to those that follow except having somewhat lobed coxae; legs thereafter normal except coxae of eleventh legs are perforate. Legs in front of gonopods not modified except that some are slightly more crassate than others.

Apterourus, new genus

Etymology: Greek, *apteros*, wingless + *oura*, tail; (masculine).

Type-species: *Apterourus horizontalis*, new species.

Description: In addition to family characters, the head densely setose with setae decreasing in length from in front to crest of vertex, behind which it is smooth; no vertigial sulcus. Antennae with joints 3 and 5 equal in length but 5 twice as thick as 3.

Segment 1 with lateral angles projecting almost horizontally; macrosetae crossing middle in an almost straight line. Segments thereafter with prozonites descending abruptly to broad constriction from which densely granular, keeled metazonites rise rapidly; posterior margin of



metazonites thin. Lateral keels broad, nearly horizontal, thin, and concave above; outer margin very oblique and irregular, the large outer seta projecting caudoectad from near its middle.

Gonopods simple, caudally directed; apices extending between ninth legs which resemble those that follow except in having lobed coxae and a wide sternum; tenth and eleventh legs with narrowing sterna.

***Apterourus horizontalis*, new species**

(Figs. 1-4)

Holotype: Male, USNM myriapod collection no. 3159.

Type locality: Holotype, another male, immature male, 2 females, from Cajon Pass, 7 mi. W of Cajon, on Big Pine Road, San Bernardino Co., California, 14 February 1929, O. F. Cook.

Description: Largest male 7 mm long, largest female 8 mm; color in alcohol dark brown.

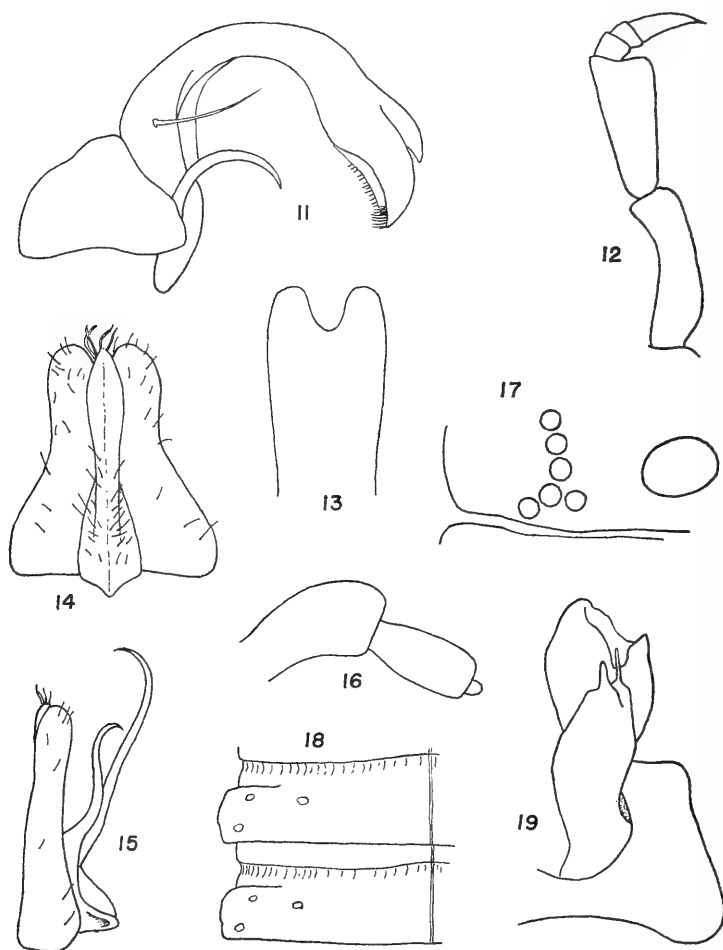
Segment 1 shown in Fig. 1, the outer limits projecting, thickened, and keel-like; surface coarsely granular, like that of keeled metazonites; granules decreasing as keels decrease in size; keelless metazonites smooth.

On following segments the thin, dorsally concave, lateral keels project widely and almost horizontally and are shaped as in Fig. 2, their size gradually decreasing to mid-body but more rapidly thereafter to segment 24, behind which they are lacking; keels of segments 2-5 bent forward, others directed outward; seta on each keel larger than setae on body which rise upward and forward on keeled segments but somewhat caudally on keelless ones. Prozonites coarsely reticulated, suddenly descending to a broad, nearly flat, interzonal constriction containing finer reticulations; convex metazonites rising rapidly from constrictions and with posterior margins long, thin, and with dorsal granules slightly projecting.

Gonopod shown in Figs. 3 and 4, developed from eighth leg only and having stout flagellum. Legs in front of gonopods normal except for the slightly swollen third pair. Ninth legs similar to others except for a distomesal tubercle on each coxa and in having a wide sternum; sterna of legs 10 and 11 narrowing, others normal; pores opening from distomesal face of coxae of eleventh legs.

←

FIGS. 1-4. *Apterourus horizontalis*, new species. 1, segment 1; 2, keel of segment 3; 3, right gonopod, ventral view; 4, right gonopod beyond side of segment, lateral view. FIGS. 5-7. *Caseya coxalis*, new species. 5, left gonopod and ninth leg, lateral view; 6, second leg of male, posterior view; 7, seventh leg of male, posterior view. FIGS. 8-10. *Cleidogona australis*, new species. 8, left gonopod, ventral view; 9, left gonopod, lateral view; 10, twelfth coxal joint and sternal peg of male, ventral view.



FIGS. 11-13. *Costaricia curvipes*, new species. 11, right gonopod, lateral view; 12, ninth male leg, posterior view; 13, lamina of twelfth male legs. FIGS. 14-16. *Tingupa arizonica*, new species. 14, gonopods, ventral view; 15, right gonopod, lateral view; 16, ninth male leg, posterior view. FIGS. 17-19. *Flagellopetalum quadratum*, new species. 17, side of head with antennal socket and ocelli; 18, left half of segments 9 and 10 with body rolled slightly to right; 19, right gonopod, anterior view.

Family CASEYIDAE

Caseya coxalis, new species

(Figs. 5-7)

Holotype: Male, USNM myriapod collection no. 3160.

Type-locality: Holotype, 2 males, 4 females, numerous young, Davenport, Santa Cruz Co., California, 21 February 1929, O. F. Cook.

Paratype localities: Male, 3 females, Santa Cruz Mts., between Santa Cruz and Holy City, Santa Cruz Co., 2 January 1928; male, female, S of Pescadero, San Mateo Co., California, 21 February 1929, O. F. Cook.

Diagnosis: Closely related to *C. similis* Causey but anterior gonopods broader and irregularly serrate at apex; large outer joint of ninth legs rimmed for a short distance in front; and coxal processes of male legs 2 and 7 longer and more slender.

Description: Length 15-16 mm, females stouter than males; body with median light band, usually quite narrow but in some specimens wide enough to include upper seta on each side. First 4 or 5 segments lacking striae above lower seta; on succeeding segments number of striae increases from 1 to 3 or 4 above the seta but they are fainter than striae below it.

Gonopod shown in Fig. 5; outer joint of ninth leg more convex than in *C. heteropus* Cook and Collins, and rimmed for only a short distance in front; coxal joint not bifid but elevated into a heavy fungiform lobe; basal portion stemlike, with a small mesal tubercle; outer portion expanded, ending in a caudally produced truncate triangle with surface deeply concave. Second pair of male legs smaller and more slender than first or third pair; coxal joint with a longer, more slender, more curved lobe than in either *similis* or *heteropus* (Fig. 6). Third leg with coxal process a little longer and more acuminate than in *heteropus*. Seventh coxae enlarged as in *heteropus* but each posterior lobe long and acute (Fig. 7). Inner processes of tenth coxae much as shown in illustration for *heteropus* but outer distal limit of each swollen into a large, thick, rounded, and laterally conspicuous projection.

Caseya dynotypa Chamberlin

This species was based on a single female with a very brief, unsatisfactory description mentioning only length and coloration but no structural character. It has not been reported again and probably can be identified only through future study of topotype material. References to the species in the Checklist of the Millipeds of North America are misspelled *dynopta*.

Caseya similis Causey

Male from Woodford, N of Tehachipi, California, 8 January 1928, O. F. Cook.

Not having seen a specimen of *C. heteropus*, and basing her comparison on its illustrations, Causey stated that the ninth legs of *similis*

were like those of *heteropus*, whereas *heteropus* has the outer joint of this leg nearly encircled by a raised rim. *C. similis* has no rim and the surface of the joint is more convex. Second male legs not smaller than first or third pair.

Family CLEIDOGONIDAE
Cleidogona australis, new species
 (Figs. 8-10)

Holotype: Male, USNM myriapod collection no. 3161.

Type-locality: Holotype and another male, Highlands Hammock State Park, Sebring, Florida, 28 November 1963, E. M. Loomis.

Diagnosis: Most closely related to *C. hadena* Causey but apex of each anterior gonopod is not finely setose along inner margin and is of different shape; coxae of legs 10 and 11 lacking protuberances present in *hadena*.

Description: Holotype 14 mm long, paratype 12 mm long.

Antennae very slender; joint 6 as long as 7, thickest at middle where it equals or exceeds thickness of any inner joint. Ocelli in 6 or 7 rows, 6-5-4-4-3-2-1 beginning near antenna of paratype, 6-5-5-4-3-1 in holotype.

Gonopods (Figs. 8, 9) most closely resembling those of *C. hadena*, but showing numerous minor differences. Joint 2 of male legs 3 and 4 more compressed from front to back than in legs following. Coxae of seventh legs much thicker than anterior ones, most of ventrally exposed face of each coxa occupied by a large, spongy or finely granular area; a small rounded tubercle present behind, near mesodistal corner. Ninth legs with basal joint in a long sigmoid curve, otherwise not unusual. Tenth legs widely separated by the long flattened sternum which has its median two-thirds increasingly raised into a broad elevation, high and strongly produced behind; next sternum narrower, shorter, and more depressed; twelfth sternum with process, shown in Fig. 10, extending forward beneath the more or less crossed coxal lobes of legs 10 and 11, the lobes subcylindrical and three times as long as broad; coxae lacking other processes mentioned for *hadena* but each with a granular area similar to that shown in Fig. 10 for twelfth coxa.

Costaricia, new genus

Type-species: *Costaricia curvipes*, new species.

Description: Although its range is far south of that of *Cleidogona*, it has many of the characters of that genus and is closely related to it. It is considerably smaller, but the gonopods present the best differences, the principal branch of each being simple, very strongly curved caudad, with apex somewhat expanded; secondary branch a rather small, attenuated, evenly curved hook. Secondary sex characters of male legs, including ninth pair, essentially those of *Cleidogona*, but lamina of twelfth legs larger than most species of that genus, and it is apically divided, thus unmistakably differentiating the two genera.

Costaricia curvipes, new species
(Figs. 11-13)

Holotype: Male, USNM myriapod collection no. 3162.

Type-locality: Holotype, 23 February 1937; female, 21 February 1937; male, March 1937, Cairo, Limon Prov., Costa Rica, H. F. Loomis.

Description: Length 10 mm; ocelli in rows paralleling lower side of head, 6-5-4-4-3-2-1, thus forming a triangular cluster.

Gonopod shown in Fig. 11. Legs if front of gonopods without secondary modifications, the first two pairs only slightly smaller than those that follow and these not noticeably crassate. Ninth leg (Fig. 12) with second joint thickest at outer and instead of near middle, as in *Cleidogona*. Coxae of legs 10 and 11 with long inflated processes, sterna between legs 9, 10, and 11 wide; sternum between twelfth legs narrow, coxae almost touching; lamina in front of twelfth legs rather thick, curving up and forward, apex bifid as seen in Fig. 13.

Family RHISCOSOMIDIDAE

Rhiscosomides sp.

Female from Santa Cruz Mts., between Santa Cruz and Holy City, California, 2 January 1928, O. F. Cook.

This female probably represents an undescribed species as it is only 6 mm long, as well as being found over 400 mi. south of the previously most southern record for the genus. It is mentioned to invite collectors to search for specimens in the area.

Tingupidae, new family

Type-genus: *Tingupa* Chamberlin.

Type-species: *Tingupa utahensis* Chamberlin.

Although I originally placed *Tingupa* in the Rhiscosomididae (Bull. Mus. Comp. Zool., 92:387, 1943), a comparison of *Tingupa arizonica*, new species, with a syntype of *Rhiscosomides meineri*, kindly sent me by Prof. Silvestri, its describer, indicates that this disposition was in error and, furthermore, that a separate family is needed for it, the only included genus, now consisting of four species and an additional subspecies. The genus runs to couplet 7 of the Key to North American families of Chordeumidea, p. 85 in the Checklist of the Millipeds of North America, the key here revised from that point to include the new families Tingupidae and Apterouridae.

Supplemental key to North American families of Chordeumidea

- 1A. Dorsum densely short-setose in addition to macrosetae and other sculpturing; segment 1 enlarged, much wider than head, anterior margin transverse and triacuate; outer macroseta each side well within lateral limits; last segment short and broadly rounded throughout behind Rhiscosomididae
- 1B. Dorsum never short-setose; segment 1 not wider than head, usually much narrower, anterior margin rounded or rounded-

- angular; outermost macroseta at lateral limit; last segment with sides oblique and nearly straight, apex truncate 2
- 2A. Gnathochilarium without a separate promentum Bactropidae
- 2B. Gnathochilarium with distinct mentum and promentum 3
- 3A. Size large, at least 14 mm long; body without strongly projecting lateral keels Cleidogonidae
- 3B. Size smaller, body 8 mm or less long, with prominent lateral keels 4
- 4A. Metazonites with dense scattering of thin, short, longitudinal carinae; macrosetae small; keels thick, following contour of dorsum, and evident to last two or three segments; ninth male legs 3-jointed Tingupidae
- 4B. Metazonites merely densely granular on keeled segments, smooth on others; macrosetae large; keels strongly projecting, almost horizontal, thin, and terminating on segment 23 or 24; ninth legs 6-jointed Apterouridae

In addition to the characters involved in the Checklist key and the above supplement, the Tingupidae have males with 28 or 30 segments; segment 1 with raised anterior rim, outer angles descending below general level; keels of succeeding segments strongly projecting, thick, almost knoblike, and each with a large depressed area behind, mesad of posterior corner, outer macroseta rising from this depression. Gonopods each composed of two rather simple, adjacent, elongate elements in front, and two long, slender, acuminate, posterior processes, one of which may be subdivided. Ninth male legs 3-jointed, basal joint long and heavy; outer joint small to rudimentary; claw absent in some species.

***Tingupa arizonica*, new species**
(Figs. 14-16)

Holotype: Male, USNM myriapod collection no. 3163.

Type-locality: Many males and females, Mt. Lemmon, elevation 8,000 ft., Santa Catalina Mts., Pima Co., Arizona, under leaves and bark of fallen pines, 30 May 1930, H. F. Loomis.

Paratype localities: Arizona: 25 specimens, type-locality, 23 April 1921; 9 males labelled only "probably Santa Rita Mts., Pima Co."; 15 specimens, both sexes, Mt. Graham, Graham Co., 9 October 1930; all above by H. F. Loomis.

Diagnosis: Readily distinguished from other species by the reduced number of segments of males, and the clawless, rudimentary third joint of ninth male legs.

Description: Sexes differing considerably in length, females reaching 8 mm, males only 6 mm and with number of segments reduced to 28. Living color uniform light brown with a pale grayish bloom that is lost in preservation, the brown darkening.

Head setose but otherwise smooth and shining, lacking ridges or a vertigial sulcus. Eyes of 10-17 ocelli in a subtriangular group with

anterior and lower sides nearly straight, posterior side concave with 5-7 ocelli. Antennae crassate; joint 5 a little longer than joint 3 and twice as thick. Gnathochilarium with several obvious differences from Chamberlin's figures for *utahensis* and *monterea*.

Segment 1 narrower than head and much narrower than segment 2; front margin bluntly angled at middle; either side nearly straight ecto-caudally to outer limits; entire margin with distinct raised rim; outer limits strongly and abruptly deflexed from a rather long, shoulderlike angulation of dorsal surface, most prominent at its posterior end, the outermost seta issuing from below the angulation with its base and the outer limit of segment not visible from above.

Segments with prozonites strongly convex, metazonites not at all; interzonal constriction broad and deep; lateral keels evident to segment 25 of males and to segment 27 of females.

Gonopods shown in Figs. 14 and 15. Ninth legs of male with joint 3 rudimentary and lacking claw (Fig. 16).

Family TRICHOPETALIDAE

Flagellopetalum quadratum, new species

(Figs. 17-19)

Holotype: Male, USNM myriapod collection no. 3164.

Type-locality: Sixteen males and females, mostly from beneath logs in comparatively dry deciduous woods, Glendale, Prince Georges Co., Maryland, 22 February 1916, H. F. Loomis.

Paratype locality: Male, Woodmoor, Prince Georges Co., Maryland, 16 February 1916, H. F. Loomis.

Diagnosis: Aside from material differences of the gonopods, this species is distinguished from *F. stannardi* Causey by being maculate with brown, rather than gray banded; lateral keels possibly projecting farther and more angular at their posterior corner.

Description: Length 4.3-5 mm, females slightly larger than males. Living color brownish and white; vertex and front of head brownish with many white patches; anterior segments maculate with brown that becomes lighter on posterior segments, last segments being white; on colored segments a large white spot behind each inner seta. In alcohol the specimens become brown.

Head with 4-7 ocelli usually in a single curving row but when there are 6-7 ocelli the sixth and seventh are located in front as seen in Fig. 17. Antennae rather crassate; joint 3 longer but considerably more slender than joint 5.

Segment 1 with a raised rim along front margin, rim thickest on outer angle. Succeeding segments with metazonites smooth and shining above, longitudinally striate on sides below keels. Lateral keels strongly projecting and continuing to antepenultimate segment; anterior corners rounded, posterior ones almost squarely angled as shown in Fig. 18. In both species of this genus the two outer

setae on each side are on the lateral keels, the inner seta adjacent but on the body, far removed from median line. Anal valves smooth with inner margins finely rimmed.

Gonopod shown in Fig. 19; ninth legs of male essentially like those of *stannardi*; fourth joint of sixth leg with a swelling, as in that species.

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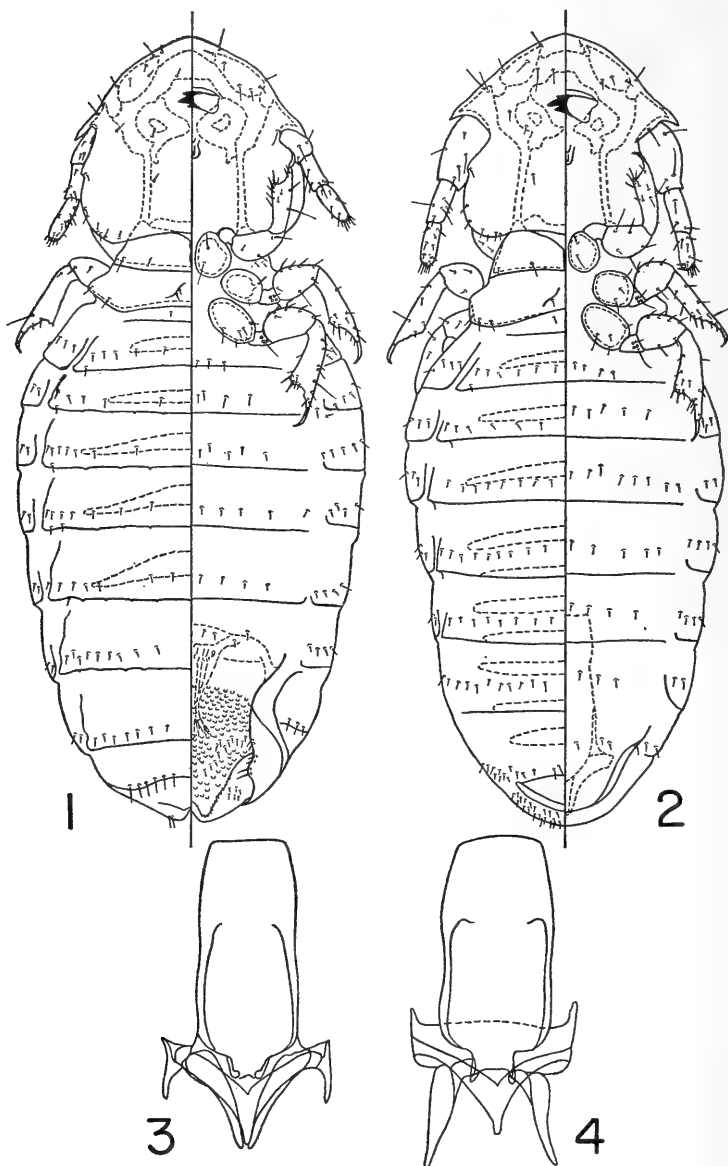
A NEW SPECIES OF *PARAFELICOLA*
(MALLOPHAGA: TRICHODECTIDAE) FROM
THE SMALL-SPOTTED GENET

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St. Paul, Minnesota*

In 1948, Werneck erected the genus *Parafelicola* for four species of Trichodectidae with these morphological features: (1) preantennal region of the head elongated and triangular, with forehead rounded; (2) antennae noticeably sexually dimorphic; (3) abdomen membranous, without large prominent pleural, sternal or tergal plates; (4) female abdomen with one small indistinct tergal plate per segment; (5) male abdomen with two small indistinct tergal plates on some segments; (6) chaetotaxy sparse, all setae minute with only one row per abdominal segment; (7) gonopods not lobed, but with a few setae on internal margins; (8) subgenital lobe of female elongated and bifurcate; (9) male genitalia with basal plate, parameres, endomeres and pseudopenis; and (10) number of respiratory spiracles variable.

The four species and their hosts are: (1) *P. acuticeps* (Neumann, 1902) found on *Genetta* sp. (probably *genetta hararensis* Neumann) from Ethiopia; (2) *P. wernecki* (Hopkins, 1941) found on *Genetta tigrina stuhlmanni* Matschie from Uganda; (3) *P. lenicornis* Werneck, 1948 found on *Genetta victoriae* Thomas from Belgian Congo; and (4) *P. viverriculae* (Stobbe, 1913) found on *Viverricula rasse* (Horsfield) from Madagascar. External morphology of each of these species was amply illustrated by Werneck.

Recently an excellent series of another species was sent to the authors for study. This species, which is new, is herewith described and illustrated.



FIGS. 1-4 *Parafelicola africanus*, new species. 1, dorsal-ventral view of female. 2, dorsal-ventral view of male. 3, male genitalia in normal position. 4, male genitalia in extended position.

Parafelicola africanus, new species

Holotype male: Total length, 1.17 mm. External morphology and chaetotaxy as shown in Fig. 2. Genitalia, less sac, when contained entirely within the abdomen as shown in Fig. 3. Genitalia, less sac, when extended outside the abdomen as shown in Fig. 4. Genital sac large and with numerous small serrations.

Allotype female: Total length, 1.16 mm. External morphology and chaetotaxy as shown in Fig. 1. Internal chamber of vulva prominent.

Discussion: *P. africanus* is without noticeable respiratory spiracles, a feature shared only with *P. acuticeps*. It can be separated from that species by: (1) the lack of two tergal plates on abdominal segments II-IV in the male; (2) more dense abdominal chaetotaxy; (3) the prominent internal vulva chamber of the female; (4) the female subgenital lobe which has a different shape and which is without serrations along the outer margins; (5) significantly smaller size in both sexes; and (6) a different male genitalia. The male genitalia differs greatly from that of *P. viverriculae*, but is of the same type as that of *P. acuticeps*, *P. wernecki*, and *P. lenicornis*. In each of these latter named species, the parameres are noticeably thicker than those of *P. africanus*.

Type host: *Genetta genetta senegalensis* (Fischer).

Type material: Holotype male, allotype female, and 23 paratypes collected off the type host at Gelbel Elba, Egypt on 11 March 1954 by Harry Hoogstraal and M. N. Kaiser. The holotype, allotype and paratypes will be deposited in the U. S. National Museum. Paratypes will be sent to collections of the British Museum (Natural History), Chicago Museum of Natural History, University of Kansas, University of California (Berkeley) and University of Minnesota.

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- WERNECK, F. L. 1948. Os Malofagos de mamiferos. Parte 1: Amblycera e Ischnocera (Phloptoridae e parte de Trichodectidae). Rio de Janeiro. 243 pp.

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A NEW SPECIES OF *RHINOPHYLLA* (MAMMALIA,
CHIROPTERA, PHYLLOSTOMATIDAE) FROM
SOUTH AMERICA¹

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Twelve specimens of *Rhinophylla* were collected in the province of Loreto, Peru, during the summer of 1964. Three of those specimens are referable to *R. pumilio* Peters, but the nine remaining specimens represent an undescribed species. For that species, I propose the name:

***Rhinophylla fischeriae*, new species**

Holotype: adult female, skin and skull; no. 12102, Texas Cooperative Wildlife Collection; from 61 mi. SE Pucallpa, about 180 m, Loreto, Peru; collected 15 August 1964 by Dillard C. Carter and prepared by Robert W. Adams, original number 1221. Selected measurements in millimeters are: head and body, 46; forearm, 31.0; third metacarpal, 30.2; tibia, 10.6; calcar, 3.8; interfemoral membrane at midline, 3.6; foot, 8; ear, 15; total length of skull, 17.1; condylobasal length, 14.9; cranial breadth, 8.0; mastoidal breadth, 8.7; interorbital breadth, 4.9; maxillary toothrow, 4.5; greatest width across molars, 6.1; greatest width across canines, 4.6.

Description: A small species of *Rhinophylla*. Body coloration varies from medium gray, with slightly reddish overcast, to pale reddish brown; wing membrane very dark brown; ears and interfemoral paler brown; interfemoral membrane with conspicuous fringe of stiff hairs which extend 2 to 3 mm beyond membrane edge. Proximal one-half of forearm, legs, feet, and interfemoral membrane conspicuously hairy. First upper incisor (I¹) bilobed, medial lobe about twice lateral lobe size, and lacking lateral cingular style. Slightly worn I¹ with lobes indistinct and cutting edge entire. First lower premolar (presumably P₁) trilobed, but lobes indistinct when worn. P₁ lobes more or less equal in size, or

¹ This contribution results from an investigation supported in whole by Public Health Service Research Grant No. AI-03743, from the National Institute of Allergy and Infectious Diseases. Contribution No. 5297 of the Texas Agricultural Experiment Station.

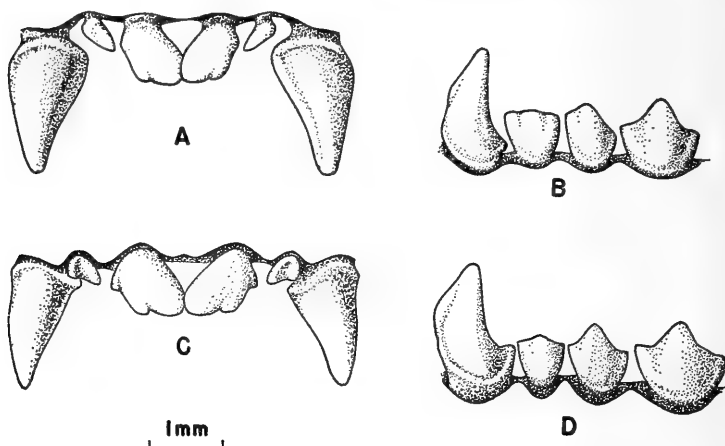


FIG. 1. Holotype of *Rhinophylla fischeriae* (TCWC 12102 ♀): A, frontal aspect of upper incisors and canines; B, lateral aspect of lower canine, premolars (P_1 and P_4), and first molar of the left ramus of the mandible. *Rhinophylla pumilio* (TCWC 12095 ♀): C, frontal aspect of upper canines and incisors; D, lateral aspect of lower canine, premolars (P_1 and P_4), and first molar of the left ramus of the mandible.

central lobe slightly larger than anterior and posterior lobes, or posterior lobe largest with middle and anterior lobes progressively smaller. Weights of one male and three females: 6.7 (male), 6.5, 6.9, and 7.0 grams.

Comparisons: *R. fischeriae* is smaller than *R. pumilio*; has an obvious fringe of stiff hairs along entire margin of interfemoral membrane; and has bilobed I^1 , which lacks a lateral cingular style. In *R. pumilio*, the margin of the interfemoral membrane is essentially naked and I^1 has three or four lobes including a well-developed lateral cingular style, which is not lost as the tooth wears.

Measurements: See table 1.

Distribution: Known from the type-locality and from the town of Pucallpa, Loreto, Peru. The specimens taken at the type-locality were caught in mist nets set on the moderately open floor of mature rain forest. The specimen from Pucallpa was taken in a mist net placed above a small pond at the local brick and roof tile factory. There was no forest near the factory.

Husson (1962, p. 152) placed the name *Rhynophylla cumilis*, Kappler, (1881, p. 163) in the synonymy of *Rhinophylla pumilio* after examining two specimens so labeled in the Staatliches Museum für Naturkunde, Stuttgart. The two specimens examined by Husson are apparently those referred to by Kappler (*loc. cit.*).

TABLE 1. Selected measurements in millimeters of nine specimens of *Rhinophylla fischeræ*. No. 12104 is from Pucallpa, Peru, the others are from the type-locality.

| | 12096 | 12097 | 12098 | 12099 | 12100 | 12101 | 12102 | 12103 | 12104 | Mean |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| | ♂ | ♂ | ♀ | ♀ | ♀ | ♀ | ♀ | ♀ | ♀ | |
| Head and body | 45 | 45 | 44 | 47 | 43 | 48 | 46 | 45 | 47 | 45.5 |
| Forearm | 29.3 | 29.9 | 31.4 | 31.0 | 32.3 | 31.8 | 31.0 | 30.9 | 31.6 | 31.0 |
| Metacarpal III | 28.7 | 29.2 | 29.9 | 31.9 | 31.5 | 31.6 | 30.2 | 29.7 | 30.2 | 30.3 |
| Greatest skull length | 16.4 | 16.9 | 16.3 | 16.6 | 16.8 | 17.6 | 17.1 | 16.6 | 17.5 | 16.8 |
| Condylobasal length | 14.4 | 14.8 | 14.6 | 14.6 | 15.2 | 15.5 | 14.9 | 14.6 | 15.7 | 14.9 |
| Cranial breadth | 7.9 | 8.2 | 7.8 | 7.7 | 7.7 | 8.2 | 8.0 | 7.7 | 7.8 | 7.8 |
| Mastoidal breadth | 8.9 | 8.6 | 8.6 | 8.3 | 8.6 | 9.3 | 8.7 | 8.8 | 8.9 | 8.7 |
| Interorbital breadth | 4.6 | 4.9 | 4.7 | 4.8 | 4.7 | 5.0 | 4.9 | 4.7 | 4.8 | 4.7 |
| Maxillary tooththrow | 4.4 | 4.5 | 4.5 | 4.3 | 4.6 | 4.7 | 4.5 | 4.4 | 4.6 | 4.5 |
| Greatest width across molars | 5.8 | 6.2 | 6.2 | 5.9 | 6.2 | 6.5 | 6.1 | 6.1 | 6.1 | 6.1 |
| Greatest width across canines | 4.4 | 4.7 | 4.5 | 4.6 | 4.2 | 4.7 | 4.6 | 4.5 | 4.9 | 4.5 |

Two males of *R. fischeræ* taken 14 and 15 August had testes measuring 4 and 5 mm. One female taken on 14 August had an enlarged uterus which may have contained a very small embryo. None of the other females appeared to be pregnant. On 15 August, both *R. fischeræ* and *R. pumilio* were caught in the same nets which were set on the forest floor.

I am especially grateful to Dr. Georg H. W. Stein, Institut für Spezielle Zoologie und Zoologisches Museum der Humboldt-Universität zu Berlin, for loaning me Peters' holotype of *R. pumilio*. Also I wish to thank Drs. Karl F. Koopman, American Museum of Natural History; Charles O. Handley, Jr., United States National Museum; and Joseph C. Moore, Chicago Natural History Museum, for the loan of specimens in their charge. Specimens deposited in the above institutions are denoted as follows: ZM, Zoologisches Museum; AMNH, American Museum of Natural History; USNM, United States National Museum; CNHM, Chicago Natural History Museum.

Etymology: The species *R. fischeræ* is named in honor of Miss Sigrid Fischer who contributed significantly to the success of our collecting trip on the rivers of Ucayali and Tamaya.

Specimens examined: *R. fischeræ*: PERU: 61 mi. SE Pucallpa, about 180 m, Loreto, 2♂♂, 6♀♀, TCWC; Pucallpa, about 180 m, Loreto, 1♀, TCWC. *R. pumilio*: VENEZUELA: Río Casiquiare, 250 ft., 1♂, AMNH. BRAZIL: Peters' holotype, no definite locality, ♀,

TABLE 2. The means and extremes in millimeters for selected variates of *R. pumilio*

| Variate | Mean | Extremes | No. and sex |
|-------------------------------------|------|-----------|-------------|
| Head and body | 50.0 | 47-54 | 4♂♂ + 2♀♀ |
| Forearm | 34.1 | 33.0-36.3 | 5♂♂ + 3♀♀ |
| Metacarpal V | 32.4 | 31.0-34.4 | 15♂♂ + 10♀♀ |
| Greatest skull length | 19.1 | 18.7-19.5 | 13♂♂ + 9♀♀ |
| Condylbasal length | 17.1 | 16.8-17.5 | 10♂♂ + 5♀♀ |
| Cranial breadth | 8.4 | 8.1- 8.8 | 13♂♂ + 11♀♀ |
| Mastoidal breadth | 9.3 | 9.1- 9.5 | 13♂♂ + 11♀♀ |
| Interorbital breadth | 4.8 | 4.6- 5.2 | 15♂♂ + 13♀♀ |
| Maxillary toothrow | 5.2 | 5.0- 5.4 | 14♂♂ + 8♀♀ |
| Greatest width across molars | 6.5 | 6.2- 6.9 | 16♂♂ + 12♀♀ |
| Greatest width across upper canines | 4.7 | 4.5- 5.0 | 15♂♂ + 12♀♀ |

ZM; Río Madeiro, Borba, 2♂♂, AMNH. ECUADOR: Sarayacu, 2♀♀, AMNH; San José Abajo, 1♂, AMNH; Boca Río Curaray, 4♂♂, 8♀♀; mouth of Curaray River, 2♂♂, USNM; Río Suno, Abajo Loreto, Oriente, 1♂, CNHM; Río Copataza, Oriente, 1♀, CNHM. PERU: Pto. Indiano (or Indiana), Río Amazonas, 4♂♂, 3♀♀, AMNH; 33 mi. SE Pucallpa, about 180 m, Loreto, 1♂, TCWC; 61 mi. SE Pucallpa, 180 m, Loreto, 2♀♀, TCWC.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

REQUIEM—FOR MEGADRILE UTOPIAS. A
CONTRIBUTION TOWARD THE UNDERSTANDING OF
THE EARTHWORM FAUNA OF NORTH AMERICA¹

BY G. E. GATES
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The origin and constitution of a major portion of the earthworm fauna of America, north of the Mexican border, long have been misunderstood, not only in Europe but also in the western hemisphere. A possibility that greenhouses could provide clarifying evidence was recognized years ago (*cf.* Gates, 1943) when I identified specimens of exotic earthworm species, otherwise unknown locally, that were obtained from wholesale American greenhouses. Investigations of animals in greenhouses of Berlin and Italy (Boettger, 1929, 1930, 1932), Berne, Switzerland (Holzapfel, 1932), Poznan, Poland (Moszynski and Urbanski, 1932) provided some oligochaete records. Other and fortuitous greenhouse records of earthworms, widely scattered through systematic and other literature, are of greater interest. Greenhouse faunas as such never were studied in America. In the fall of 1952, I began collecting in retail greenhouses, mostly in Maine. Some of the data was included in a previous publication (Gates, 1963); the remainder is recorded here. Other material was provided by Harold Davies, Dorothy McKey-Fender, and Professors Harman and Murchie.

All greenhouses mentioned below are heated during cold months and elsewhere often are called forcing houses or hot houses to distinguish them from those that are not heated. Collecting from plant benches usually was inadvisable while plants were growing and was futile after the earth had dried. Records are for groups of buildings rather than for individual

¹ From research supported by the National Science Foundation.

houses in a set. Unless otherwise indicated, I was the collector. The customary method of indicating megadrile growth stages is by three figures (following the date of collection) which tell the number of juvenile, aclitellate and clitellate specimens, respectively. A fourth number, if mentioned, states the number of postsexual aclitellate individuals. The year of collection often was lacking on the label of the specimens and so cannot be included below.

LUMBRICIDAE

ALLOLOBOPHORA Eisen, 1874*Allolobophora chlorotica* (Savigny, 1826)

DISTRICT OF COLUMBIA. Washington, Greenhouses, Poplar Point Nursery, U. S. Botanical Gardens, 5 March 1954, 0-5-1. Collector: W. J. Harman.

Remarks: Other greenhouse records are for New York, Massachusetts, Maine, Finland, Poland, France, Switzerland. *A. chlorotica* is not common in central Maine.

Allolobophora longa Ude, 1885

MAINE. Bangor, Bangor Floral Company, soil under plant benches, 22 December, 2-0-0, 7 January, 1-0-0. Sunnyside Greenhouses, soil under plant benches, 28 February 1953, 5(+ 7?)-0-0. Hard earth above stiff clay floor under plant benches, 5 November 1953, 5(+ 27?)-0-0. Lougee-Frederick greenhouses, soil under plant benches, 25-26 November, 1(+ 7?)-0-0. Seavey greenhouses, soil under plant benches, 13 December, 1(+ 8?)-0-1.

Remarks: *A. longa*, recorded from botanical gardens and arboretums of several countries and not uncommon in central Maine, hitherto had not been reported from greenhouses.

Allolobophora trapezoides (Duges, 1828)

MAINE. Waterville, Flo's greenhouse, soil under plant benches, 23 June, 12(+ 87?)-0-5-2, 11 August, 17-2-4-7. (At least some of 24 recently hatched juveniles of *Allolobophora* sp., may have been of this species.) DISTRICT OF COLUMBIA. Washington, Greenhouses, Poplar Point nursery, U. S. Botanical Gardens, 5 March 1954, 0-5-1. Collector: W. J. Harman.

Remarks: *A. trapezoides* was previously unrecorded from American greenhouses, probably, in part, because it was confused with other species (*cf.* notes to Table 1). Specimens never were obtained outdoors anywhere in Maine.

Earth on plant benches of the Maine greenhouse had not been changed for 16 years (at least) and at end of each growing season was allowed to dry for 2-3 weeks.

TABLE 1. Presence of European earthworms in greenhouses and in Pacific Coastal states. G—Greenhouses. W—Washington. O—Oregon. C—California. (+) New state record. (?) Present in British Columbia and anticipated in Washington. (H), (E), Holarctic, Euro-american, according to some European specialists.

| | | G | W | O | C |
|---------------------------------|-----|-----|-----|-----|-----|
| <i>Allolobophora chlorotica</i> | (E) | + | + | + | (+) |
| <i>A. limicola</i> | (E) | | | | |
| <i>A. longa</i> | (E) | + | | | |
| <i>A. muldali</i> | (E) | | | | |
| <i>A. trapezoides</i> | | + | (+) | (+) | (+) |
| <i>A. tuberculata</i> | | + | (?) | | (+) |
| <i>A. turgida</i> | | + | (+) | (+) | (+) |
| <i>Dendrobaena mammalis</i> | (E) | | | | |
| <i>D. octaedra</i> | (E) | | + | | + |
| <i>D. rubida</i> | (H) | + | + | + | + |
| <i>Eisenia foetida</i> | (H) | + | + | + | + |
| <i>E. hortensis</i> | (E) | (+) | | + | + |
| <i>E. rosea</i> | (H) | + | + | + | + |
| <i>Eiseniella tetraedra</i> | (H) | + | (?) | + | + |
| <i>Lumbricus castaneus</i> | (E) | + | | + | |
| <i>L. festivus</i> | (E) | | | | |
| <i>L. rubellus</i> | (E) | + | + | + | + |
| <i>L. terrestris</i> | (E) | + | + | + | + |
| <i>Octolasion cyaneum</i> | (H) | + | | | (+) |
| <i>O. tyrtaeum</i> | (H) | + | + | + | + |

Notes: *Allolobophora trapezoides*, *tuberculata*, *turgida*, along with *nocturna*, and perhaps other unrecognized species, formerly were included in a taxon known as *caliginosa* that was characterized as holarctic. *Octolasion tyrtaeum* formerly was known as *Octolasion lacteum*. *Eisenia rosea*, by some Europeans, is included in *Allolobophora* but like each of the six species in the table, *limicola* to *turgida*, does not belong in any genus of which *chlorotica* is the type species.

Allolobophora tuberculata Eisen, 1874

MAINE. Bangor: Bangor Floral Company, earth of plant benches, 14 October 0-17-31. Soil under plant benches, 22 December, 30-6-1; 7 January (several small juveniles?)—2-4. Earth of plant benches, 7 March, 9(+ 8?)—1-21-1. Bangor Nursery, earth of plant benches, 14 October, 13-17-31, 20 October, 14-4-4. Lougee-Frederick greenhouses, soil under plant benches, 28 November, 0-0-2. O'Loughlin's greenhouses, soil under plant benches, 28 November, 0-0-2. Seavey's greenhouses, soil under plant benches, 13 December, 6(+ 7?)—3-2-1. Sunnyside greenhouses, hard earth above stiff clay floor under plant benches, 5 November, 2(+ part of 19 smaller juveniles?)—4-3. In earth (brought in the previous fall) of plant bench, 28 February, 0-0-6. In earth under plant benches, 18-20 April, 8-0-0. Bar Harbor: Dorrance greenhouses, soil

under plant benches, 25 May, 4-0-4. Browning greenhouses, soil under plant benches, 25 May, 2-0-1. Malvern Flower Shop, soil under plant benches, 25 May, 2-0-2. McIntosh greenhouses, soil under plant benches and 1-2 inches beneath a layer of coal cinders, 25 May, 5-0-0. Ellsworth: Clark greenhouses, soil under plant benches, 24 March, 63-0-10-2. Orono: University of Maine greenhouses, earth of plant benches, 25 October, 8-2-8. Waterville: Flo's greenhouse, soil under plant benches, 23 July, 0-1-1. 11 August, 4-2-1.

Remarks: Not previously reported from greenhouses. Common throughout central Maine.

Allolobophora turgida Eisen, 1874

MAINE. Bangor: Bangor Floral Company, earth of plant benches, 20 October, 0-0-1. Soil under plant benches, 22 December, 0-0-1, 7 January, 0-0-1. Sunnyside greenhouses, hard earth above stiff clay floor under plant benches, 25 November, (some of 19?)-0-4. Soil under plant benches, 18-20 April, 4-2-16 (some in copulation). Bar Harbor: Malvern Flower Shop, soil under plant benches, 25 May, 0-1-1-1. Ellsworth: Clark greenhouses, soil under plant benches, 24 March, 0-0-0-3. Waterville: Flo's Greenhouse, soil under plant benches, 23 July, 0-0-1. 11 August, 0-0-7.

Remarks: Not previously reported from greenhouses. Not as common in central Maine as is *A. tuberculata*.

DENDROBAENA Eisen, 1874

Dendrobaena rubida (Savigny, 1826)

MAINE. Bangor: Bangor Nursery, earth of plant benches, 14 October, 0-0-3. Bangor Floral Company, earth of plant benches, 20 October, 0-0-3. Soil under plant benches, 7 March, 0-0-6. Lougee-Frederick greenhouses, soil under plant benches, 25 November, 0-1-0. Sunnyside greenhouses, soil under plant benches, 25 November, 0-0-1. Ellsworth: Clark greenhouses, soil under plant benches, 24 March, 4-0-0. Orono: University of Maine greenhouses, earth of plant benches, 25 October, 1-0-2. Waterville: Flo's greenhouse, soil under plant benches, 23 July, 9-3-0. 11 August, 14-13-3-1. Specimens were of athecal morphs.

CONNECTICUT. Greenwich: Compost heap outside the Saxon-Krueger greenhouses, 27 August 1957, 0-1-0. (Compost heap comprised discarded plant materials taken outside.)

Remarks: Most specimens were of thecal morphs known in the past as *D. subrubicunda*.

An additional Maine record, hitherto unpublished, is of some interest in connection with the subsequent discussion. Sandy loam, 4½ feet below ground level, in unfloored cellar of a dwelling house at Benton Station, 15 September 1950, 0-1-0. H. S. Smith.

Outdoors the worm had burrowed down to a level below the foundations which were then tunnelled under so as to come to the surface in-

side the cellar. The species is not usually regarded as one of the deep burrowing forms.

Other greenhouse records are for Finland, Poland, Germany, Switzerland, Italy.

EISENIA Malm, 1877

Eisenia foetida (Savigny, 1826)

MAINE. Bangor: O'Loughlin greenhouses, in soil under boards beneath plant benches, 28 November, 2-0-0. Lougee-Frederick greenhouses, soil under plant benches, 25-26 November, 6-0-0. Bangor Floral Company, manured earth of plant benches, 7 March, 1-0-2. Bar Harbor: Dorrance greenhouses, soil under plant benches, 25 May, 1-0-0. Malvern Flower Shop, manured earth of plant benches and in soil underneath benches, 25 May, 16-9-6. Ellsworth: Clark greenhouses, soil under plant benches, 25 March, 4-2-0.

Remarks: Other greenhouse records are for Illinois, Maryland, Massachusetts, Sweden, Poland, Germany, Wales.

E. foetida is widely distributed in central Maine but, in any township, provides only a small proportion of the megadrile population because of drastic ecological restrictions.

Eisenia hortensis (Michaelsen, 1890)

MICHIGAN. Masury, Trumbull County, 0-0-2. Collector: W. R. Murchie.

Remarks: Previously recorded from a greenhouse and a conservatory in Maine as well as from a hot bed with a temperature of 80-85° F at Ardsley, New York. Another of the very few North American reports was for a toilet bowl in Cleveland.

Eisenia rosea (Savigny, 1826)

MAINE. Bangor: Bangor Floral Company, earth of plant benches, 14 October, 0-0-2, soil under plant benches, 22 December, 0-0-1, 7 January, 1-0-3, 7 March, 2-5-10-3. Sunnyside greenhouses, hard earth above stiff clay floor under plant benches, 5 November, 0-0-5, 28 February, 0-0-3. Lougee-Frederick greenhouses, 25-26 November, 0-0-8. Seavey greenhouses, soil under plant benches, 13 December, 6-1-2. Bar Harbor: Dorrance greenhouses, soil under plant benches, 25 May, 8-1-2. Browning greenhouses, soil under plant benches, 4-0-0. Ellsworth: Clark greenhouses, soil under plant benches, 24 March, 10-4-16-3. Orono: University of Maine greenhouses, in earth of plant benches, 25 October, 0-0-1. Waterville: Flo's greenhouse, soil under plant benches, 23 July, 2-0-2.

Remarks: Other greenhouse records are for Oklahoma and Italy. *E. rosea* is common outdoors throughout central Maine.

EISENIELLA Michaelsen, 1900

Eiseniella tetraedra (Savigny, 1826)

MAINE. Ellsworth: Clark greenhouses, soil under plant benches, 24 March, 0-0-4. Waterville: Flo's greenhouse, soil under plant benches, 23 July, 46-2-4. 11 August, 9-2-4. DISTRICT OF COLUMBIA. Washington: Greenhouses, Poplar Point nursery, U. S. Botanical Gardens, 5 March 1954, 0-0-4. Collector: W. J. Harman.

Remarks: All specimens were of morphs with male pores in xiii. *E. tetraedra* is fairly widely distributed in central Maine but is present at few sites, three of which are in Bangor and vicinity.

Other greenhouse records are for Indiana and Finland.

LUMBRICUS Linnaeus

Lumbricus castaneus (Savigny, 1826)

MAINE. Bangor: Lougee-Frederick greenhouses, soil under plant benches, 25-26 November, 1-0-0. Bangor Floral Company, earth of plant benches, 7 March, 0-1-2. Orono: University of Maine greenhouses, earth of plant benches, 25 October, 2-0-0.

Remarks: Other greenhouse records are for Finland and Poland. *L. castaneus* is fairly common throughout central Maine.

Lumbricus rubellus (Hoffmeister, 1843)

DISTRICT OF COLUMBIA. Washington: Greenhouses, Poplar Point nursery, U. S. Botanical Gardens, 5 March 1954, 0-1-2. Collector: W. J. Harman. OREGON. Dayton: Greenhouse, 14 July 1946, 0-1-29. Collector: D. McKey-Fender.

Remarks: Other greenhouse records are for Poland and Italy.

The species is rare in central Maine where, during a twenty-year survey, only 53 specimens were secured outdoors.

Lumbricus sp.

MAINE. Waterville: Flo's greenhouse, soil under plant benches, 23 July, 1-0-0. (Probably not *terrestris*. Identification impossible because a portion of the tail was lacking and the anterior region was damaged.)

Lumbricus terrestris Linnaeus

MAINE. Bangor: Bangor Floral Company, soil under plant benches, 22 December, 3-0-0, 7 March, 1-0-0. Sunnyside greenhouses, hard earth above stiff clay floor under plant benches, 5 December, 2-0-0. Lougee-Frederick greenhouses, soil under plant benches, 25-26 November, 4-0-0. Seavey Greenhouses, soil under plant benches, 13 December, 1-0-0. Bar Harbor: Dorrance greenhouses, soil under plant benches, 25 May, 0-1-1. (Specimens also were present in earth of the plant benches.)

Remarks: Except in one house, all specimens were juvenile and quite small.

Other greenhouse records are for Indiana, Illinois, and Switzerland. *L. terrestris* is widely distributed and common in central Maine.

OCTOLASION Oerley, 1885

Octolasion cyaneum (Savigny, 1826)

MAINE. Bangor: Bangor Floral Company, earth of plant benches, 14 October, 0-1-1, soil under plant benches, 7 January, 9-0-0. Bangor Nursery, earth of plant benches, 14 October, 0-1-1.

Remarks: In central Maine this species was found only at six other sites two of which were flower beds outside the greenhouses.

The only other greenhouse record is for Finland.

Octolasion tyrtaeum (Savigny, 1826)

CONNECTICUT. Greenwich: Compost heap outside Saxon-Krueger greenhouses, 26 August, 1957, 0-0-1.

Remarks: *O. tyrtaeum* is rare in central Maine where it was not found in greenhouses.

The only previous greenhouse record was for Naples, Italy.

MEGASCOLECIDAE

PHERETIMA Kinberg, 1866

Pheretima agrestis (Goto and Hatai, 1899)

MAINE. Waterville: Flo's greenhouse, soil under plant benches, 11 August, 0-0-2.

Remarks: This is the first record of the species from a greenhouse.

Pheretima diffringens (Baird, 1869)

NEW JERSEY. Chatham, greenhouses, August 1954, 0-4-9. Collector: H. Davies.

Remarks: Types of this oriental species were secured from an orchid bed in a Welsh "plant stove." Similar worms had been present in an English hot house since 1849. Subsequently the species was reported from greenhouses in France (1870, 1871), Denmark (1886), Scotland (1890), Germany (1892), Russia (1896), Illinois (1915), Poland (1933), Oregon (1936), and Maine (1963). *P. diffringens* probably was the, or one of the, species present as early as 1888 in Illinois greenhouses.

The single record for Nebraska was, from soil in the vicinity of greenhouses. Outdoors in Europe, *P. diffringens* has been found in gardens around greenhouses of France, Portugal and Italy. In America, the species has been collected outdoors in California, Texas, Arkansas, Louisiana, Tennessee, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, Pennsylvania, New Jersey, New York, Connecticut, Mexico, Guatemala, Salvador, Costa Rica, and Panama. Recorded sites in Connecticut, New York, New Jersey and Pennsylvania are few, but in many of the other states the species is more widely distributed.

Other colonizations: In Americas, San Domingo, Trinidad, Colombia,

Peru, Brazil. In the other hemisphere, Sardinia, Azores, Egypt, Anjouan, Cape Verde Islands, St. Thomas, St. Helena, South Africa, Madagascar, Ceylon, India, Burma, Sumatra, Java, Philippines, Australia, New Caledonia, New Zealand, Fiji and Hawaiian Islands. The species is widely distributed in Hainan, Taiwan, China, Korea, and Japan. In some portion of the latter area it's original home is to be sought.

Pheretima hilgendorfi (Michaelsen, 1892)

CONNECTICUT. Greenwich: Compost heap outside Saxon-Krueger greenhouses, 26 August 1957, 0-0-6, 28 October 1957, 0-0-3. (*cf.* record for *D. rubida*.)

Remarks: Earthworms could not be collected in the greenhouses but the species probably was taken out to, rather than in from, the compost heap.

Pheretima levis (Goto and Hatai, 1899)

CONNECTICUT. Greenwich: Compost heap outside Saxon-Krueger greenhouses, 26 August 1957, 0-0-7, 28 October 1957, 0-0-19.

Remarks: Earthworms could not be collected in the greenhouses but the species probably was taken out to, rather than in from, the compost heap.

Pheretima morrisi (Beddard, 1892)

MICHIGAN. Campus greenhouse, Flint College, Genesee County, 20 February 1961, 0-0-9. Collector: W. R. Murchie.

Remarks: Previous greenhouse records are for Bangor, Maine, Poughkeepsie, New York, and England.

DISCUSSION

A twenty-year survey of the megadrile fauna of central Maine, involving identification of thousands of earthworms, showed presence outdoors only of lumbricids belonging to 14 species. Eleven of them were found in greenhouses. *Dendrobaena octaedra*, *Lumbricus rubellus*, and *Octolasion tyrtaeum* were secured at very few sites and then only in habitats from which the taking of soil to local greenhouses is unlikely. Two of those species have been found in greenhouses elsewhere and there is very good reason (to be presented subsequently) for believing that *Dendrobaena octaedra* would have been found indoors long ago, if more than a few searches had been made.

Greenhouses and conservatories in which plants were raised only from seeds and/or bulbs usually harbored no foreign worms, *i.e.*, of species absent outdoors in the same region. Earthworms of those buildings probably arrived with the earth for the plant benches. However, deep burrowing species, such as *Allolobophora longa*, *Lumbricus terrestris*, *et al.*, could have gotten in by tunneling under the foundations as floors are lacking.

On several occasions earthworms actually were found in the animal manure and/or compost that was being taken inside as fertilizer. Co-

coons were not sought but probably would have been present in almost all of the bench materials that went into Maine greenhouses. Once inside, the worms spread to the more or less undisturbed soil of the floorless areas and to odd corners or niches where dirt or accumulations of plant matter provide appropriate shelter, food and moisture. Bench earth of one greenhouse had not been changed for at least 17 years, but had been allowed to dry out for a short period before being again put to use. A much more usual practice was to discard the earth at the end of a growing season, or at various intervals ranging from one to several years, and then to refill the benches with fresh earth from some supposedly favorable site. Cocoons, or perhaps less often diapausing individuals, could have remained behind even in crannies of the wooden benches which in the past were not sterilized. Indeed, *Allolobophora chlorotica* was found so often inside greenhouses and so rarely outdoors as to lead to a belief that in Maine (and perhaps also in some other New England states) more individuals of the species were taken out than were brought in.

The numbers of specimens obtained, even in small areas of some greenhouses, and the condition of the individuals in comparison with that of worms of the same species from mines, caves, and various outdoor sites, seemed to indicate that the ivied aisles of greenhouses generally provided for earthworms of several species a habitat that was optimal with regard to moisture, temperature, and food, as well as shelter from many enemies. Indeed, that seems to have been learned by Englishmen well over a hundred years ago (*cf.* Baird, 1869) as was proved by complaints that pheretimas had become so numerous in their greenhouses as to block the drains. Perhaps long ago, marked increases in the number of foreign megadriles was found to be one good reason for frequent changing of earth in plant benches. Accordingly, even a small business or private hobby may provide opportunity for rapid multiplication and subsequent distribution throughout a local area of foreign earthworms. An instance of the beginning of one such distribution was detected recently (Karpinen and Nurminen, 1964) in Finland—the spreading of *O. cyaneum*, otherwise unknown in the country, from a local greenhouse first to one garden and then to others in the same area.

Some small organizations purchase, perhaps more often now than in the past, partly or fully grown plants from wholesale businesses. If buildings of the much larger concerns are infected with earthworms, a rapid and widespread distribution of megadriles therefrom would seem to be possible. Wholesale houses that were investigated in the thirties and early forties were indeed sheltering foreign earthworms.

Central Maine greenhouses were found to harbor nine foreign species that are present outdoors only at varying distances beyond the state. *Pheretima agrestis*, for example, is present in the Arnold Arboretum of Boston (Gates, 1953), and beyond that not until Greenwich (Connecticut), Long Island (New York), and Swarthmore (Pennsylvania).

In contrast, *P. bicincta* has been collected outdoors in this hemisphere only in the West Indies.

The self-acquired range of the genus *Pheretima* (Gates, in press) is comprised of: the Andaman Islands, the mainland of Asia from the Chindwin-Irrawaddy axis of Burma east through Yunnan and Szechuan provinces of China to include Korea and Japan, then south through New Guinea, Java, and Sumatra. Salt water usually is believed to be fatal to earthworms which are therefore unlikely to migrate overseas. During the present century no one has suggested seriously that extra-oriental distributions of pheretimas were achieved other than by fortuitous transportation. The only agent definitely known to have engaged in such transoceanic carriage, for the most part unintentionally, is man. Ten species of *Pheretima* have been recorded from the mainland United States where distributions, each marked by wide discontinuities often involving geographical barriers, are fortuitous and indicative of rather recent introduction. Each species now has been reported from American greenhouses or (two species) from the immediate vicinity of such buildings, out of which the worms probably were taken. In greenhouses, pheretimas are known to have survived demolition of the superstructure by fire (Gates, 1963), removal of all earth from plant benches, and drouth of several weeks duration. Once well established indoors, some species are known to have existed without recruitment from outside for periods of 17 to 25 years. Discarding the earth from plant benches, whether annually or at less frequent intervals, often must have resulted in massive inoculations of various age stages, as well as of cocoons, into whatever area the discarded earth was dumped. Certainly, for more than a century, pheretimas went out of European greenhouses in greater numbers than went inside. Yet, in spite of all such transfers, none of the species has been recorded from outdoor sites in Wales, England, Scotland, Denmark, Poland, Germany, Russia, or even in Maine where they must have been present in some greenhouses as long ago as 1920. All of the data subsequently secured, supports the conclusion (Gates, 1963) that greenhouses, in certain parts of the world, have provided centers for introduction, multiplication and local distribution of exotic earthworms originally from China, Japan.

Absence of pheretimas from Maine to Russia, after more than a century of repeated introductions and inoculations, indicates that the species involved cannot survive in those places. Climatic factors presumably are responsible, and temperature seems especially important.

The twenty lumbricid species of Table 1 originated in a western portion of the Eurasian land mass and that origin never has been questioned. However, there are differences of opinion as to the adjectives by which each of those worms are characterized. Holarctic and Euro-american (*cf.* Omodeo, 1963, *et al.*) are the terms used by some Europeans. Holarctic seems more likely to convey an erroneous idea than to communicate information about two species of *Octolasion* that are unrecorded from Alaska, Canada, and Greenland. *Eisenia foetida* once was recorded

from Vancouver and once was said (without mention of localities) to be present in one or more of the eastern provinces, but since has not been reported from any part of Canada, nor from Alaska and Greenland. The only Canadian record for *E. rosea* is that of an Ontario bog not far from the United States boundary. *Allolobophora caliginosa*, also supposedly Holarctic, was a long-used name for a complex containing *Allolobophora nocturna*, *trapezoides*, *tuberculata*, *turgida*, and possibly other unrecognized species. The original home of *nocturna* is unknown. *Allolobophora trapezoides* may have evolved in a region with a mediterranean climate and so is unlikely to be found in most of Canada. Holarctic is, of course, much more applicable to *Dendrobaena rubida* and *Eiseniella tetraedra*, but does not hint at the presence of both species in Mexico, Central and South America, Australia, New Zealand, South Africa, and many oceanic islands.

Data that should be noted about so-called Euro-american species are as follows: *Allolobophora muldali* is known only from three sites, in Michigan, Wales, and England. *Dendrobaena mammalis* has been found only once outside Europe (including the British Isles) and then at a single New Jersey site. *Lumbricus festivus* was thought to be present in one or more eastern provinces of Canada (but as yet without confirmation) and the literature provides no support for its supposed presence in the Alleghenies. In the American hemisphere, *Allolobophora limicola* has been found only at the Arnold Arboretum in Boston and at three sites in New Jersey. *Eisenia hortensis*, though recorded from eight states, is encountered but rarely and never was reported from Alaska, Canada, and Greenland.

Allolobophora longa and *Lumbricus terrestris*, on the basis of published distributions, would seem to be much more entitled to a holarctic characterization than *Eisenia foetida* and the two species of *Octolasion*. The same sort of data provides no obvious reason for excluding *Allolobophora chlorotica*, *Dendrobaena octaedra*, *Lumbricus castaneus* from a group containing *Dendrobaena rubida* and *Eiseniella tetraedra*. A characterization of Euro-american gives no hint as to presence elsewhere of the following species: *Allolobophora chlorotica*, in New Zealand, South America, various oceanic islands. *A. longa*, Australia, New Zealand, South Africa. *Eisenia hortensis*, South America, South Africa, oceanic islands such as the Azores. *Lumbricus rubellus*, New Zealand, South Africa, oceanic islands such as Tristan da Cunha; *Lumbricus terrestris*, Australia, New Zealand, South America, South Africa, oceanic islands such as the Azores and Madeira. Anthrochores of European origin, seems to be the most meaningful characterization of the species in Table 1.

American zoologists are apt to regard common European forms with which they long have been more or less familiar, perhaps since boyhood angling days, as native species. For example, *Lumbricus rubellus*, present at almost every location in Washington west of the Cascades where any earthworms are found (Altman, 1936), was said to be "our most common

endemic earthworm." Unfamiliar pheretimas, when encountered occasionally, on the contrary, are assumed by almost everyone to be exotic.

Divergence of opinion on the above-mentioned characterizations of earthworm species doubtless results from different beliefs as to time of arrival in America of species that admittedly are of European origin. My view, first expressed in print more than three decades ago (Gates, 1929a,b), is that "In a large portion of the glaciated area of North America we can not, of course, expect to find indigenous species of earthworms. This part of the continent is inhabited by peregrine lumbricids presumably introduced by man." The same belief more recently (Gates, 1960) was restated with reference to that part of the continent north of Mexico and east of the Pacific coastal strip, "37 (over 60%) of the species in the area now under consideration became domiciled more or less widely after introduction by man." No date was mentioned but another article (Gates, 1954) did say that European lumbricids "probably have been established in the United States for 150 years or more." Some ornithologists were, and still may be, stymied by the problem of the woodcock's diet if there were no earthworms in New England and Canada until some time after 1500 A. D. But, was the preColumbian range of the woodcock the same as now? Furthermore, if the Colorado potato beetle abandoned the deadly night shade for the more nutritious potato in vast plantings, might not a change to a more luscious diet be possible for the woodcock?

Centuries are far from sufficient, according to Omodeo (1963), who presented to a recent symposium on North Atlantic Biota, indirect proofs, inductive arguments, data from biometric and caryological studies, as well as very convincing direct proofs that there is "only one explanation for the type of distribution we are dealing with, the existence of a land-bridge across the North Atlantic along which the earthworm fauna of Europe moved to North America." That involved, according to the same author, a species age of 38-50 million years for *Lumbricus terrestris* and its presence in North America for a million years, also the survival of European lumbricids in Greenland and Iceland during "all of the Last Glacial and maybe the entire Quaternary."

Until geologists do find evidence supporting existence of a north Atlantic bridge at the proper time (*cf.* Wright and Frey, 1965, p. 620, etc.) Occam presumably would favor postulating, in place of migration, transportation. Carriage not only is now assumed for the remainder of this discussion, but carriage solely by man. No other agent has been shown to take earthworms around the entire world as man obviously has done. The most likely way, probably the most common one, by which megadriles were transported is in earth around roots of live plants.

The questions next requiring answers are: How long has man (presumably European) been bringing European earthworms to North America along with live plants, and is such a period of time adequate?

Columbus took live plants to Hispaniola on his second transatlantic voyage, but faunas of the West Indies, Mexico and Central America need

no consideration here. Celts, from one place or another, may have settled beyond the Orkneys to escape the Vikings, as the latter did believe, but records are lacking. Norse sagas relating the colonization of Iceland and Greenland, as well as the futile attempt to settle Vineland (probably a southeastern peninsula of Newfoundland), provide no data on plant carriage. Laborious and usually unrewarding searches of various sources, on the contrary, provided some more or less definite seventeenth century dates, for trees brought to the Atlantic colonies (excepting the French in Canada), in tubs or boxes with earth around their roots: 1611 to 1612, vines and orange trees to Virginia (but from the West Indies). Probably after 1681, plants sent to Pennsylvania by Wm. Penn. About 1647, Peter Stuyvesant's pear tree to New Amsterdam, New York; 1638, Pearmain apple to Charter Oak Place; before 1650, Wyllis' apple to Hartford and Tryan's Pearmain to Weathersfield, Connecticut; 1630, Governor Winthrop's pear tree (Boston?); 1640, Governor's Prince's pear to Cape Cod; about 1643, a Bergamot pear to Roxbury. All these localities are in Massachusetts. Before 1670, an apple tree was taken to Gorgeana (now York), Maine. Other records probably can be provided by further literature searches. (Most of the just mentioned records now may be found in Hedrick, 1950.) Although occasional importation by more prosperous colonists of one or more trees obviously could, and probably did, bring earthworms to the United States, objections may be raised that the present distributions could not have been so obtained.

Greenhouses, as already indicated, might have permitted rapid multiplication, and then more rapid and wider distribution. A history of the greenhouse business, so far as could be ascertained, remains to be written, but among data secured from various sources the following (also *cf.* Hedrick, 1950) are cited.

The first greenhouse in New England was built between 1707 and 1737. A little later, a second, also in Boston, was erected. A greenhouse with orange trees was known to have been in Williamsburg, Virginia, about 1737. The New York Mercury of 2 October 1758, contained the advertisement of a "surveyor who designs "Greenhouses. . . .with winding funnels through the Wall, so as to keep them warm." Greenhouses seem to have been common in the Philadelphia region around 1760 when Bartram got stone to build his own. Robert Morris had hothouses for orange, pineapple and other tropical plants at one of his estates. A greenhouse is known to have been in New York City during 1764 and shortly afterwards, there were many others, some of them conservatories of estates on the east bank of the Hudson. An extensive conservatory and "two species of hothouses" had a frontage of 180 feet in the Elgin Bontanic Garden, on land, part of which now contains the Rockefeller center, New York City, in 1805. During 1825-1860, wealthy estates in Tennessee and Kentucky had greenhouses. The Belmont mansion, near Nashville had three buildings each 300 feet long for camellias, grapes, tropical fruits. Even in Maine, with a climate unfavorable to civilization according to Toynbee (1935), greenhouse plants were

on sale shortly after 1841. At Bangor, then almost on the very frontier, Sekenger's business, begun in 1850, expanded until in 1899 there were 11 greenhouses each 50 feet long in addition to three, each of which was 100 feet long.

Floral business, during the 1930s, was believed to have become one of the leading industries in the United States. The number of square feet under greenhouse glass, according to the U. S. Census of Agriculture for 1959, was 178,500,370 in 1929, 191,400,495 in 1949, 227, 674,395 in 1959. Those figures do not include private conservatories, farms or businesses with annual receipts from horticultural products of less than \$2,000. Even in Toynbee's climatically unfavorable Maine, the greenhouse area for 1959 was 1,080,683 sq. ft. During 1929, there were sold in the United States alone, from greenhouses, nearly 122 million potted plants. At that time, many if not most of the thousands of greenhouses (some present in every one of the 48 states) are likely to have sheltered earthworms. One successful establishment outdoors of a single species per greenhouse per annum theoretically could have resulted, after a few years, in colonization of almost every inhabited continental portion of the entire country. European species, that supposedly came to this continent along a North Atlantic bridge are unlikely to have continued westward so as eventually to climb the continental divide and cross the more western mountain ranges. Those species are more likely to have been taken to the Pacific coastal areas of three states and a Canadian province (cf. Table 1) in the same way as they were taken to South Africa, South America, Australia, and New Zealand, *i.e.*, along with live plants.

During the last few years (perhaps five or more), searches through greenhouses of organizations in or near large cities revealed no trace of earthworms. Steam and chemical sterilization, replacement of natural earth by sand, gravel, cinders, etc., feeding plants by nutrient solutions, solid floors, perhaps also other newer practices, had exterminated species that may have been present in the past, and presumably will keep earthworms out of the buildings in the future. Hence, the title of this contribution. However, in smaller businesses, away from very large cities, long continued practices are likely to be less rapidly modified or abandoned. From European greenhouses, zoologists easily secured live specimens, otherwise unobtainable, of exotic species for studies of anatomy, physiology, cytology, as well as of various protozoan and nematode parasites. For such studies some exotic megadriles decreasingly will be available to American zoologists and with the disappearance of the last greenhouse worms there also may have been lost opportunities to secure pertinent data as to arrival here of species such as *Dendrobaena mammalis* and *Allolobophora muldali*.

SUMMARY

Data now available in print show that exotic species of non-lumbricid earthworm families transported around the world in earth surrounding roots of live plants could have been propagated in the favorable environ-

ment provided by greenhouses from whence the worms could have been distributed more or less widely in accordance with sales patterns of potted plants. Colonization presumably is allowed or inhibited by climatic conditions in accordance with genetically determined tolerances. Lumbricid species, admittedly of European origin, could have been brought intermittently to the United States along with live plants during the last 355 years. For 250 years, some, perhaps many of those twenty kinds, could have been propagated in American greenhouses. From thence the worms could have been distributed outdoors on a gradually increasing scale. The growth of retail and wholesale horticultural businesses in the country has been such as to warrant a belief that it could have been responsible for a considerable portion of the distributions of the European species as now known.

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PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

LEEWARD ISLANDS *TYPHLOPS*
(REPTILIA, SERPENTES)

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Snakes of the genus *Typhlops* Oppel have long been known to inhabit some of the Leeward Islands (Boulenger, 1893; Barbour, 1914), but it was Parker (1933) who first indicated their true relationships by placing them with *T. jamaicensis* Shaw. At that time specimens of *Typhlops* were known from St. Christopher, Antigua and Montserrat, but there were not enough to delimit variation. Recent collecting has produced substantial series of specimens from Antigua and Montserrat; a few other specimens have also been taken on St. Christopher, Nevis, and Barbuda. The related Puerto Rican and Virgin Island species, *T. richardi* Duméril and Bibron, has been dealt with (Thomas, 1966), but study of the Leeward Islands form was not undertaken at that time for lack of material.

To Dr. Albert Schwartz I am most indebted for his sponsorship of the collecting and study of the Leeward Islands *Typhlops*. I also wish to thank the following people for the loan of specimens in their care: Drs. Doris Cochran and James A. Peters, U. S. National Museum (USNM); Miss Alice G. C. Grandison, British Museum (Natural History) (BMNH); Dr. Walter Auffenberg, University of Florida Collections (UF). Mr. A. F. Stimson of the British Museum made comparisons with a syntype of *Anilius leachii*, for which he has my sincere thanks.

Additionally, institutions in which typical specimens of the new taxa described below have been deposited are designated as follows: MCZ, Museum of Comparative Zoology at Harvard; CM, Carnegie Museum; UIMNH, University of Illinois Museum of Natural History; KU, Museum of Natural History, University of Kansas. ASFS designates the Albert Schwartz

Field Series, and RT designates the Richard Thomas private collection.

METHODS AND TERMINOLOGY

Labial flare of rostral: The rostral of some forms widens noticeably at the labial border; this labial flare is numerically expressed as the ratio of the width of the rostral at the level of the nares to the widest point of the labial flaring.

Apical flare of rostral: The rostral of some forms widens noticeably on the apex of the snout; this is expressed numerically as the ratio of the narrowest point of the rostral in ventral aspect to the greatest width on the apex of the snout. (All such measurements are made with an ocular micrometer.)

Scale row reduction: Reduction of scale rows occurs on the ventral surface by fusion of the first two paramedian rows, or sometimes by fusion of the midventral row with the first paramedian row. The level of reduction is indicated as the number of midventral scales posterior to the mental at which fusion of rows takes place. As reduction is not necessarily symmetrical (*e.g.*, 22 rows may reduce to 21 and then to 20 shortly thereafter), only the final reduction of a major reduction is usually given; *i.e.*, for the major reduction from 22 to 20 rows (or 20 to 18) the level at which reduction from 21 to 20 (or 19 to 18) occurs is all that is stated. When abnormal redivision and refusion occurs, reduction is indicated as the level at which the fusion occurs that continues for a greater distance than those preceding it. If redivision and refusion is too erratic, a count is not taken. It should be noted that for the posterior reduction the procedure used here is a change from that used with *T. richardi* (Thomas, 1966) in which the posteriormost reduction was given as the number of midventral scales anterior to the vent.

Pigmented scale rows: Pigmented rows are counted around a zone at approximately midbody using a dissecting microscope. The ventralmost two rows on a side are counted as one if the number of pigmented scales in them is complementary (*i.e.*, if the pigmented scales in both would together form a nearly solidly pigmented row), or if the pigmented scales in the lowermost row are very sparse (distinctly less than half).

Boulenger (1893) listed *Anilios leachii* Gray, 1845 (no type-locality), as a synonym of *Typhlops lumbricalis* Linnaeus. Primarily because of the name *leachi*, which has been applied to a Leeward Islands iguanid lizard (*Anolis bimaculatus leachi* Duméril and Bibron), it was thought best to determine precisely the application of the name *Anilios leachii*. I have examined one of the two syntypes (BMNH 1946-1.12.5) and, although exceptionally large, it unquestionably is a specimen of *Typhlops jamaicensis* (a species I consider to be restricted to Jamaica). The specimen, an adult female, measures 425 mm total length, tail 7 mm; middorsal scales 442; scale rows 22, unreduced posteriorly; details of

head scalation like those of *T. jamaicensis* with the rostral flaring prominently on the apex of the snout but having no appreciable labial flare. The other syntype was examined for me by Mr. Stimson, who reported that it agrees with *T. jamaicensis* in the details of scalation just mentioned, rather than with the Leeward Islands form. Thus, *Anilius leachii* is a junior synonym of *Typhlops jamaicensis* and is not pertinent to the problem of the Leeward Islands *Typhlops*.

The Leeward Islands *Typhlops*, although related to *T. richardi* and *T. jamaicensis*, are best considered a separate species which may be called, in a somewhat indirect allusion to one of the islands which they inhabit,

***Typhlops monastus*, new species**

Diagnosis: A species of *Typhlops* of the *jamaicensis* complex characterized by having 22 scale rows anteriorly, reducing to 20 scale rows on the posterior portion of the body in most specimens.

Range: Presently known from the West Indian islands of St. Christopher, Nevis, Montserrat, Antigua, and Barbuda.

***Typhlops monastus monastus*, new subspecies**

Holotype: MCZ 81112, an adult male, collected between Lawyers River and Cassava Chaut, St. Peter's Parish, Montserrat, British West Indies, 5 August 1965, by Richard Thomas.

Paratypes: BRITISH WEST INDIES, MONTSERRAT: BMNH 1931.10.18.158-59, 1934.4.1.2.; St. Peter's Parish: ASFS V6674-78, Cassava Chaut, 1 August 1965, R. Thomas; ASFS V6698-701, same data as holotype, 1 August 1965, R. Thomas; CM 40591, Sweeneys (SE Carr's Bay), 2 August 1965, R. Thomas; USNM 157905-06, same data as holotype, 4 August 1965, R. Thomas; UIMNH 61659-60, 0.6 mi. N Salem Village, 6 August 1965, R. Thomas; MCZ 81113, UF 21510-11, RT 1337, same data as holotype, 6 August 1965, R. Thomas; ASFS V6793-95, same data as holotype, hatched 3 September 1965, from eggs collected 1 August 1965, R. Thomas; St. Anthony's Parish: BMNH 1924.2.19.9-11, Richmond (Estate?); MCZ 81114, taken from gizzard of *Falco sparverius* collected west slope, South Soufriere, 1400 feet, 5 April 1962, R. F. Klinikowski; ASFS 19394, west slope, South Soufriere, 1300 feet, 7 April 1962, A. Schwartz; CM 40592, approx. 0.75 mi. NE Upper Galway's Estate, 2 August 1965, R. Thomas; ASFS V6720, south side Belham River near mouth, 3 August 1965, R. Thomas; AMNH 94165-66, approx. 0.5 mi. N Roche's Estate, 4 August 1965, R. Thomas.

Diagnosis: The nominate subspecies of *T. monastus*, characterized by a high number of middorsal scales, a low degree of labial flare of the rostral, a greater number of pigmented scale rows, and pigmentation extending onto underside of tail.

Range: As presently known, the island of Montserrat.

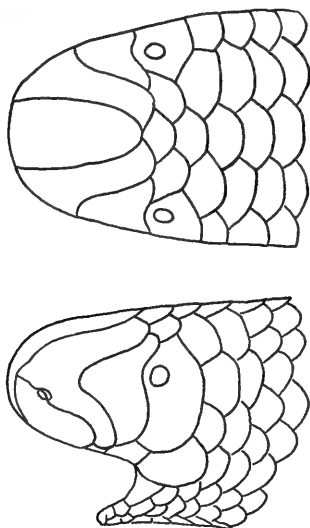


FIG. 1. Dorsal and lateral views of the head of the holotype of *Typhlops monastus monastus* (MCZ 81112).

Description of holotype (Fig. 1): Head tapers slightly from eighth middorsal scale, snout blunt and rounded. Rostral scale oval in dorsal aspect, slightly less than one-third head width at eyes; rostral narrower in ventral aspect, labial flare slight (.81), apical flare absent, posterior extent dorsally to just anterior to preocular-ocular suture. Nasals only narrowly separated from contact behind rostral; nasal sutures complete from second supralabials to rostral edge. Preocular roughly half as long as high, its anterior extension rounded; preocular in contact with third but not second supralabial. Ocular roughly half as long as high, ocular-preocular suture sinuate; two postoculars not elongate and about size of normal body scale; dorsal extent of upper postocular to above eye. Parietals 4, equal in size, only slightly enlarged and not elongate, anteriormost pair extend ventrally along ocular to level of dorsal edge of eye; supraoculars slightly smaller than parietals; eye size moderate. Middorsal scales from rostral to caudal spine 377; scale rows 22 anteriorly, reducing to 20 at level of 254th midventral scale posterior to mental; midventral scales mental to vent 365. Total length of holotype 184 mm, tail 6 mm, midbody diameter 4.7 mm. Everted hemipenes short (less than half length of tail), clavate with flattened trumpetlike apices and no ornamentation; sulcus spermaticus enters organ on medial surface, spirals posteriorly and laterally onto anterior surface, proceeds directly onto apical face.

Coloration: Gray-brown dorsally, head pigmented except for light

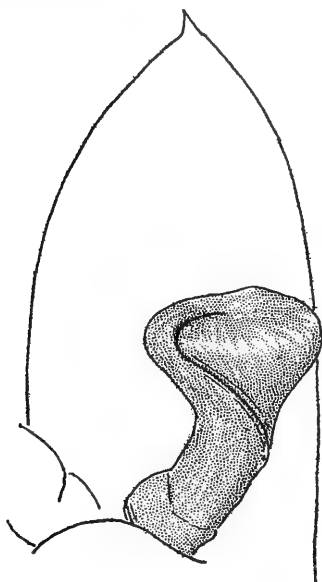


FIG. 2. Everted right hemipenis of *Typhlops monastus* (CM 40594).

scale edges, labials, and lower halves of nasals and rostral; body coloration fades somewhat on sides but zone of juncture with ventral coloration is abrupt, but irregular, caused by all-or-nothing pigmentation of individual scales; pigmented rows 13; venter off-white, probably pinkish in life; caudal light ring or notch absent, pigmentation extending completely around tail.

Variation: Head shape and arrangement and general shape of head scales of paratypes are like those of holotype; nasals broadly separated (but less than prefrontal width) to nearly in contact behind rostral; rostral extends posterior to a level just anterior to ocular or, in one or two specimens, to a level with the anterior edge; labial flare of rostral .72-.94. Middorsal scales 351-394 (mean 378.6) in type-series; reduction to 20 scale rows occurs from 187 to 299 (mean 250.7) scales posterior to mental in the midventral line; one specimen (BMNH 1931.10.18.158) does not reduce from 22 rows, another (BMNH 1924.2.19.10) reduced only to 21 rows ten scales anterior to the vent. Midventral scales 346-385 in 22 paratypes. Largest specimen measures 258 mm total length, tail 6 mm. Hemipenes are everted on five specimens besides the holotype, and are similar to the illustrated example (Fig. 2). Coloration of paratypes is much like that of the holotype; extension of pigment onto ventral part of tail occurs to some degree in all specimens; pigmented scale rows on body are 13 (16 specimens) or 15 (15 speci-

mens). Detailed reductions and measurements of labial flare were not determined for the three hatchlings.

Evans (1955) has described the osteology of *Typhlops monastus* based on 19 specimens from Montserrat. The number of vertebrae was given for 17 specimens (range 200–205). Regrettably, scale counts were not given and there is no way of determining the ratio of vertebrae to middorsal scales on an individual basis, as has been done by Gans and Taub (1965) for several East African species of *Typhlops*. However, comparison of the vertebral range obtained by Evans with the range of middorsal scales in the type-series of *T. m. monastus* (351–394) indicates that a ratio (vertebrae : middorsals) intermediate between 1 : 2 and 2 : 3 probably occurs in this population.

***Typhlops monastus geotomus*, new subspecies**

Holotype: MCZ 81115, an adult, collected approximately 1 mi. N Carlisle, St. Mary's Parish, Antigua, British West Indies, 8 August 1965, by Richard Thomas.

Paratypes: BRITISH WEST INDIES, ANTIGUA: USNM 142038, W. L. Schmitt, BMNH 65.5.4.144, BMNH 94.9.20.9–10, BMNH 99.6.29.16, BMNH 1927.4.20.33; St. George's Parish, Gunthorpes, BMNH 1940.2.4.42; St. Paul's Parish, ASFS V6767–71, Sweets Village, 7 August 1965, R. Thomas; St. Mary's Parish, CM 40593–94, KU 93352–53, AMNH 94267–68, UIMNH 61661–62, same locality as holotype, 7 August 1965, R. Thomas; UF 21512–13, MCZ 81116–18, same data as holotype; Great Bird Island: ASFS V6791, 11 August 1965, R. Thomas. BARBUDA: Codrington: USNM 137827, G. A. Seaman; UF 11376, 30 June 1958, Wayne King. ST. CHRISTOPHER: ASFS 19789, Christ Church Nichola Town Parish, 3 mi. SW Molyneux, 4 May 1962, A. Schwartz; UF 11395, St. Thomas Middle Island Parish, 3.5 mi. N, 8 mi. W Basseterre, 11 July 1958, Wayne King. NEVIS: ASFS 19783, St. George Gingerland Parish, White Bay, 1 May 1962, R. F. Klinikowski.

Diagnosis: A subspecies of *T. monastus* differing from the nominate race in having fewer middorsal scales, a higher degree of labial flare, and reduced pigmentation shown in the fewer pigmented scale rows and the lack of ventral caudal pigmentation.

Range: Presently known from the West Indian islands of St. Christopher, Nevis, Antigua, Barbuda, and Great Bird, a satellite of Antigua.

Description of holotype: Head tapers slightly from about seventh middorsal scale; snout blunt and rounded. Rostral scale elongate, oval in dorsal aspect, about one-third head width at eyes; rostral narrower in ventral aspect, labial flare moderate (.74), apical flare absent, posterior extent of rostral dorsally to slightly anterior to ocular. Nasals narrowly separated from contact behind rostral; nasal sutures complete from second supralabials to rostral edge. Preocular roughly half as long as high, its anterior extension rounded; preocular in contact with third but not second supralabial. Ocular roughly half as long as high, ocular-

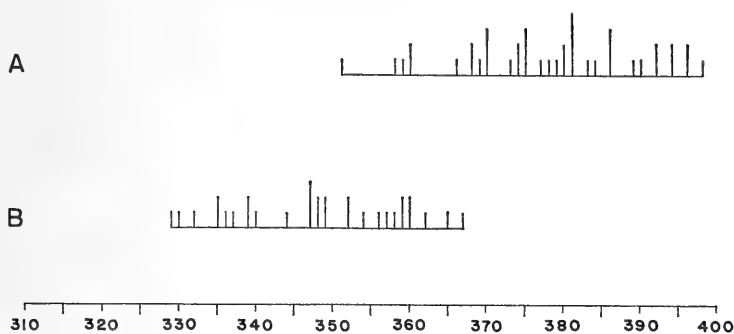


FIG. 3. Histogram of middorsal scale counts (abscissa) in *T. m. monastus* (A) and *T. m. geotomus* (B); the smallest vertical unit represents one individual.

preocular suture sinuate; two postoculars not elongate, about size of normal body scale, extent of dorsal postocular to above eye. Parietals 4, equal in size, only slightly enlarged, equal to about two neck scales (right second parietal somewhat reduced), anteriormost pair extend ventrally along ocular to level of top of eye; supraoculars slightly smaller than parietals; eye moderate in size, placed anteriorly in ocular scale. Middorsal scales from rostral to caudal spine 347; scale rows 22 anteriorly, reducing to 20 at level of 135th midventral scale posterior to mental; midventral scales mental to vent 338. Total length of holotype 196 mm, tail 5 mm, midbody diameter 4.9 mm.

Coloration: Gray-brown dorsally on body and on head excluding lower halves of nasals and rostral; body color fades gradually on sides but is nevertheless dichotomously distinct from whitish ventral color; pigmentation does not extend to underside of tail, slight indication of a caudal notch is present near tip.

Variation: Morphologically the paratypes show essentially the same variation noted for the nominate race. Labial flare of rostral significantly greater, varying from .61-.74. Middorsal scales 329-367 (mean 348.4) in type series. Reduction to 20 scale rows occurs from 138 to 231 (mean 207.9) midventral scales posterior to mental in 28 specimens. All specimens reduce to 20 rows. Midventral scales 316-350 in 19 paratypes. The largest specimen measures 213 mm total length, tail 5 mm. Hemipenes are everted in eight specimens and are like those described for the holotype of *monastus*. Coloration of paratypes is like that of the holotype; extension of pigment onto ventral portion of tail or pronounced caudal notches or rings do not occur. Pigmented scale rows are 9 (1 specimen), 11 (25 specimens), or 13 (6 specimens).

Intraspecific comparisons: The two races of *T. monastus* are distinguished by the following characters: 1) middorsal counts (Fig. 3) in which, although there is a large overlap of range, only 15 percent of

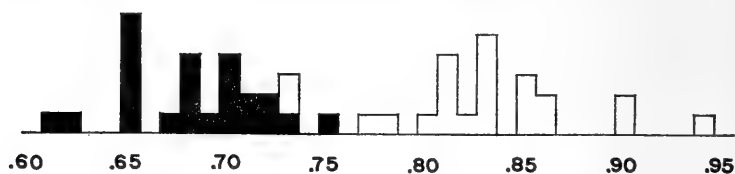


FIG. 4. Histogram showing labial flare of rostral (abscissa) in *T. m. monastus* (hollow blocks) and *T. m. geotomus* (solid blocks); the smallest vertical unit represents one individual.

the specimens of *monastus* overlap the counts of *geotomus*; 2) pigmented rows, in which 79 percent of the *geotomus* specimens are separable from all specimens of *monastus*, although because of the small total range all specimens of *geotomus* are distinct from only 47 percent of the *monastus*; 3) labial flare (Fig. 4), in which 91 percent of the *geotomus* have a higher degree of flare than all specimens of *monastus*; 4) pigmentation of the underside of the tail (*monastus*) versus its lack (*geotomus*) appears to yield a complete separation. (BMNH specimens were not used in the determination of labial flare, or ventral tail pigmentation because they had been returned before these characters were employed. Hatchlings were not used in the computation of labial flare.)

The distributional picture presented by the races of *T. monastus* is interesting because the race *geotomus* appears to occupy both the volcanic islands of St. Christopher and Nevis and the predominantly calcareous second-cycle islands (older, limestone capped) of the Antigua Bank. Montserrat, lithologically similar to St. Christopher and Nevis, bears a separate race. No ready explanation presents itself, but unequal evolutionary rates, or asynchronous dispersal in the Leewards are two possibilities. The tendency towards reduced number of pigmented rows appears to be correlated with the dryer habitats; this condition is also seen in the Virgin Islands races of *T. richardi* (Thomas, 1966).

Interspecific comparisons: *Typhlops monastus* has been called a *jamaicensis*-group member because its most obvious comparisons are with *T. jamaicensis* and *T. richardi*. Whether this group is a definable entity is another matter. Its members are characterized by general (but not detailed) similarity in the configuration of head scales, in the dorsal aspect of the head which is slightly tapering and roughly ogival to blunt in outline, in dorsal coloration which ends abruptly in an irregular zone of juncture with the light ventral color (not a trait of *T. r. richardi* and some *T. r. platycephalus*) in having 22 scale rows, at least anteriorly, and in having high middorsal scale counts (ca. 330 to 400+). A comparatively large caudal spine also seems to characterize this group. None of these characters are entirely lacking in other groups of *Typhlops*. I concur with Legler's (1959) suggestion that *T. monensis* Schmidt might be a member of this group. Having examined both living and

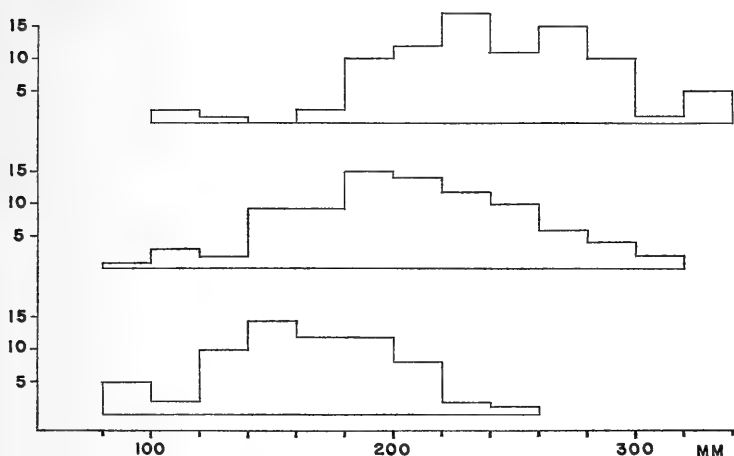


FIG. 5. Histograms of total lengths (abscissa) in three species of *Typhlops*: *jamaicensis* (top), *richardi* (middle), *monastus* (bottom). The syntype of *Anilius leachii* examined (425 mm total length) was not included in the *jamaicensis* histogram. The number of individuals is indicated on the ordinate of each graph.

preserved *monensis*, I believe it likely to be a derivative of *richardi*, which it resembles in coloration, head shape and caudal spine development, and not a relative of *T. lumbricalis* Linnaeus, as has been assumed in the past.

By its small size, *monastus* differs from both *T. jamaicensis* and *T. richardi* (Fig. 5), although in the latter there is some geographic variation in size. From *jamaicensis*, *monastus* differs further in having a narrower rostral, in lacking the prominent apical flare of the rostral, and in the reduction to 20 scale rows (*jamaicensis* reduces to 20 or 21 rows exceptionally and very far posteriorly; two specimens of *monastus* do not reduce to 20 rows). Hemipenially *monastus* and *jamaicensis* are similar in having relatively short, terminally enlarged, trumpetshaped organs; however, *monastus* appears to lack the distinctive peripheral sulcus around the apex of the organ found in *jamaicensis* (see Thomas, 1966; Fig. 5). From *richardi*, *monastus* differs principally in hemipenial structure, the former having a very long, slender organ with no terminal expansion but with a prominent basal expansion which may provide the necessary retaining mechanism during copulation. The anterior border of the ocular is more sinuous in *monastus* in which there is a curvature that accommodates the eye; in *richardi* the curvature is less pronounced or absent. The lower half of the ocular is concave in *monastus* but straight in the majority of *richardi* specimens. *T. monastus* additionally differs on the average from *richardi* in further posterior reduction of scale rows.

From other West Indian *Typhlops*, *monastus* is distinguished by the following characters:

1. 22 scale rows versus 20 or fewer in: *lumbricalis*, *sulcata* Cope, *capitulata* Richmond, *haitiensis* Richmond, *caymanensis* Sackett, *rostellata* Stejneger, *granti* Ruthven and Gaige, *monensis*.
2. 22 scale rows versus 24 (anteriorly) in: *dominicana* Stejneger.
3. More middorsal scales than: *lumbricalis*, *pusilla*, *monensis* (average), *rostellata* (average), *syntherus* Thomas (average).
4. Lack of contact of the preocular with the second supralabial versus presence of contact in: *biminiensis* Richmond, *caymanensis*.
5. Two postoculars versus one in: *biminiensis*, *caymanensis*, *sulcata*, *haitiensis*, *syntherus*.
6. Fewer middorsal scales than present in: *biminiensis*, *haitiensis*, *dominicana* (average).

The above information is taken from the literature and from personal observation. *Typhlops* sp. from the island of Guadeloupe immediately to the south of Montserrat is currently under study by Neil D. Richmond; specimens I have examined of this form attain a much larger size than *monastus* and have 24 scale rows on the anterior part of the body.

The geographical distribution of the *jamaicensis* complex is puzzling. If the forms involved do comprise a natural group it is strange that Hispaniola should lack a member. However, such gaps in distribution are not entirely unknown in Antillean reptiles. The *scaber* group of *Sphaerodactylus* which inhabits Cuba and Hispaniola has its nearest relatives in the Lesser Antilles but none in Puerto Rico. The *bilineatapyrites* group of *Leptotyphlops* has one member in Hispaniola and another in the southern Windwards (Thomas, 1965a). Such distributions may be relict; this is almost certainly the case with *Leptotyphlops*. They may on the other hand be due to the vagaries of dispersal; or, in the case of animals like *Typhlops* in which relatively few taxonomic characters are used, the "missing" member may be merely hidden by evolutionary alteration of one or two of the group characters.

Habitat: On Montserrat *T. monastus* preferred open or not heavily wooded habitats. Despite considerable collecting in wet, wooded montane areas, only one specimen and a clutch of eggs were found in such a situation. The others were found in open pastureland, cultivated clearings, sparse, intermediate level woods, scrub transitional between more arid lowlands and the mesic interior, or in the open fern growth found in many parts of the island. Elevation, however, was not a factor, for specimens were taken in some of the higher areas investigated. On Antigua, specimens were collected in an artificially mesic area of human habitation, where they were taken under a compost pile and beneath piles of palm trash. Another region successfully collected was a mesic ravine in the low hills on the southern part of the island. The specimen from Great Bird Island was taken under a rock on a beach about 20 feet from the water's edge; a low, succulent halophyte

was growing in the immediate vicinity. Barbuda is an even more xeric island than Antigua. One specimen was collected under a rock in a stone wall in an exposed situation in Codrington (Wayne King, pers. comm.). The ASFS St. Christopher specimen was collected in rain forest, and the Nevis specimen was collected in a maritime *Coccoloba* habitat.

Etymology and orthography: *Typhlops* is a Greek compound noun of feminine gender as Savage (1950) has pointed out. Of the names proposed, *monastus* (from the Greek for monastery) is a noun used in apposition to the generic name, and *geotomus* (from the Greek for ploughing) is an adjective in which the masculine and feminine endings are identical, as is also the name *syntherus* (Thomas, 1965b).

Specimens examined (other than holotypes and paratypes designated above): *Typhlops jamaicensis*, 86 ASFS specimens; *Typhlops richardi* (see Thomas, 1966) plus 25 additional ASFS specimens; *Typhlops monensis*, 5 ASFS specimens.

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PROCEEDINGS
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NEW BATS OF THE GENUS *STURNIRA*
(PHYLLOSTOMIDAE) FROM THE AMAZONIAN
LOWLANDS OF PERÚ AND THE WINDWARD
ISLANDS, WEST INDIES

BY LUIS DE LA TORRE

*University of Illinois and Field Museum of Natural History,
Chicago, Illinois*

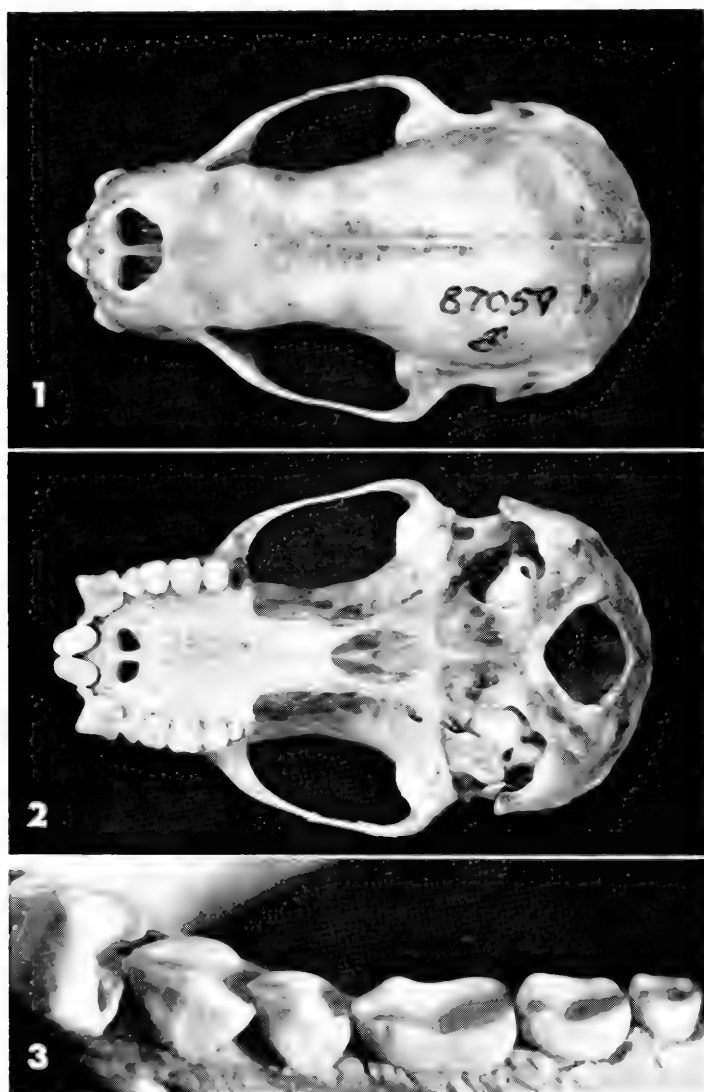
The study of the bats of the genus *Sturnira* from South America and the West Indies has resulted in the finding of two previously undescribed species. One, the largest of all the species of *Sturnira*, occurs in the eastern lowlands of Perú associated with the Rio Ucayali basin. The other occurs in the forested parts of the islands of Dominica and Martinique in the West Indies. The purpose of this paper is to name and describe these interesting species.

I am grateful to Albert Schwartz for the opportunity to study the important series of *Sturnira* collected by him and his colleagues in the West Indies. These specimens are in his private collection (ASFS). I also wish to express my appreciation to Richard G. Van Gelder and Karl F. Koopman, American Museum of Natural History (AMNH); Charles O. Handley, Jr., U. S. National Museum (USNM); Barbara Lawrence, Museum of Comparative Zoology (MCZ); and S. Dillon Ripley, formerly of the Peabody Museum (PM), for their cooperation and interest in facilitating my study of the *Sturnira* material in their collections.

***Sturnira magna*, new species**

Figs. 1-3

Holotype: Adult male (skin and skull), no. 87059, Field Museum of Natural History, from Santa Cecilia (100 m), Río Manítí, Iquitos, Department of Loreto, Perú, collected by Celestino Kalinowski, 3 January 1957, original field no. 2172.



FIGS. 1-3. *Sturnira magna*, FMNH 87509, holotype: 1, dorsal view of skull ($\times 2.7$); 2, ventral view of skull ($\times 2.7$); 3, lateral view of left mandibular tooth row ($\times 10.5$).

Distribution: Known only from the Amazonian lowlands of north-eastern and central Perú.

Diagnosis: The largest known species of *Sturnira*; lower incisors trilobed; metaconid of first and second molars extending posteriorly as a gradual sloping ridge; entoconid absent; upper molars with low, rounded labial and lingual cusps.

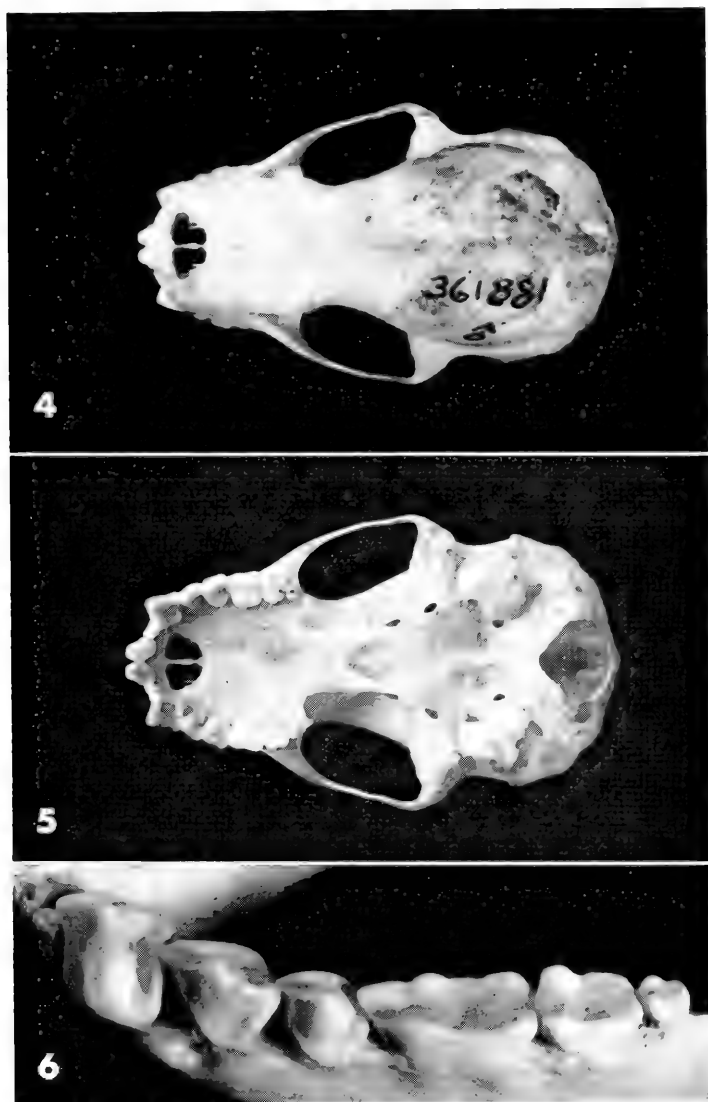
Description: Overall color of pelage yellowish or golden brown; hair white at base; epibasilar band (about 2.5 mm) light grayish brown; subterminal band broad (about 3.5 mm), light buff; terminal band narrow (about 0.5 mm) and dark brown. Proximal two-thirds of forearm relatively heavily haired on dorsal and ventral surfaces; posterior edge of interfemoral membrane with fringe of long hair, about 6 mm at level of knee. Feet large (19–21 mm), dorsal surface covered with hair. Skull proportions essentially as in *S. ludovici* Anthony but skull much larger and broader with broad zygomatic breadth; teeth relatively small (only slightly larger than in largest specimen of *S. ludovici*); upper teeth with cusps rounded and reduced in height; upper tooth rows arching symmetrically; mandibular teeth similar to those of *S. ludovici* except with lower cusps; molars flatter, with broader occlusal surface than in *S. ludovici*; paraconid, protoconid, and metaconid relatively well separated; entoconid completely suppressed; lower incisors trilobed, with middle lobe slightly lower than lateral lobes.

Comparisons: The large size of the wing and the corresponding large size of the skull in addition to the peculiarities in dentition described above, distinguish *S. magna* from all known species of *Sturnira*. *S. mordax* Goodwin is a much smaller species with a long, narrow skull and with long tooth rows.

Remarks: It is noteworthy that such a large and distinct species as *Sturnira magna* has remained undiscovered for so many years. It probably occurs throughout the Rio Ucayali basin and associated drainages of northeastern Perú.

Measurements: Measurements of holotype (in italics) followed by the mean and extremes of five male and three female paratypes (all measurements in mm): forearm, 56.3, 57.4 (56.3–59.6); metacarpal III, 55.0, 57.6 (55.0–59.0); metacarpal IV, 56.0, 57.8 (56.0–59.0); metacarpal V, 58.5, 60.2 (58.5–62.8); greatest skull length, 29.0, 28.7 (27.9–29.1); condylobasal length, 25.6, 26.1 (25.5–26.5); zygomatic breadth, 17.4, 17.1 (16.3–17.4); mastoid breadth, 15.4, 15.1 (14.4–15.4); palatal length, 13.3, 13.2 (12.4–13.3); interorbital constriction 7.7, 7.5 (7.1–7.7); postorbital constriction 7.4, 7.2 (7.0–7.4); maxillary tooth row, 7.8, 7.7 (7.3–7.9); maxillary width, 9.5, 9.3 (9.0–9.6); mandible, 19.2, 18.0 (18.3–19.2); mandibular tooth row 8.9, 8.7 (8.1–8.9). Collector's measurements of the holotype (in italics) and of the specimen from San Juan are as follows: forearm, 58, —; head and body, 90, 88; foot, 21, 21; ear, 22, 21; weight, —, 50 gms.

Paratypes: Total, 8. PERÚ. Department of Loreto, Iquitos, Río Maniti, Santa Cecilia (110 m), 4 (FMNH). Department of Pasco,



FIGS. 4-6. *Sturnira angeli*, USNM 361881, holotype: 1, dorsal view of skull ($\times 2.7$); 2, ventral view of skull ($\times 2.7$); 3, lateral view of left mandibular tooth row ($\times 10.5$).

Province of Oxapampa, San Pablo (900 ft), 3 (AMNH), San Juan (900 ft), 1 (USNM).

Sturnira angeli, new species

Figs. 4-6

Sturnira lilium, Allen, 1911, Bull. Mus. Comp. Zool., 54: 233 (Dominica).

Holotype: Adult male (skin and skull), no. 361881, United States National Museum, from 6 mi. NE Roseau (1000 ft), St. Paul Parish, Dominica, Windward Islands, West Indies, collected by R. F. Klinikowski, 21 February 1962, original no. ASFS 5354.

Distribution: Known from the islands of Dominica and Martinique.

Diagnosis: A species of *Sturnira* of medium size: hair long and dark grayish brown in color; interfemoral membrane heavily furred. Lower incisors trilobed; paraconid of first molar well developed; protoconid separated from paraconid by a low interconnecting ridge; protoconid of first molar well developed, highest of all cusps; metaconid and entoconid low and rounded.

Description: Dorsum dark grayish brown; hair with narrow white basal band (less than 1 mm) followed by relatively broad dark grayish-brown band, an equally broad buff band, and narrow, very dark reddish-brown apical band. Underparts dull dark brown; throat and ventral region similarly colored; hair with narrow white basal band followed by broad, dark brown band and terminating in dull grayish-brown band. Dark epibasal band of dorsum becomes paler and narrower anteriorly while the subterminal band increases in width and becomes paler.

Skull relatively long with small braincase and long rostrum; rostrum and braincase lower in height than in *S. lilium* as seen in profile; labial cusps of upper molars forming a sharp ridge as is typical of *S. lilium*, but commissure between protocone and metacone of first molar shallow, not deeply concave as in *S. lilium*; upper and lower third molars smaller than in *S. lilium*; lower incisors trilobed; lingual cusps of lower molars reduced as compared with *S. lilium*; paraconid well developed but low in height, extending anteriorly as relatively low ledge; paraconid and protoconid of first molar well separated, not fusing with each other; metaconids and entoconids low and separated from each other by shallow notch (not deep as in *S. lilium*). Shape of tooth rows essentially as in *S. lilium*.

Comparisons: *S. angeli* differs from *S. lilium* in being smaller, in having a completely different skull shape, and in having low, rudimentary metaconids and entoconids. From *S. ludovici* *S. angeli* differs in having trilobed lower incisors, and in possessing metaconids and entoconids. From *S. mordax* and *S. tildae* it differs in skull shape, in having *lilium*-like upper molars, in having lower molars with more distinct metaconids and entoconids, and in having the protoconid displaced labially, resulting in a continuous trough from the anterior to the posterior part of the tooth. In *S. tildae*, *S. mordax*, and *S. ludovici* the

paraconid, metaconid, and protoconid are close together and are not ridge-like as in *S. angeli*.

Remarks: According to Albert Schwartz (personal communication) the series from the vicinity of Roseau, Dominica, was taken in nets set across two streams 25 and 15 feet in width. He describes these streams as "fairly placid and not torrential at the localities of the nets" and states further that "... here we took *Artibeus* commonly in the same nets (although *Brachyphylla* only rarely)." Both streams were in rain forest with no adjacent cultivated areas.

This distinct species is named for an individual whose lifetime of teaching and practicing of perfection in another field has materially influenced my own philosophy in biology. It is named in honor of my father, Angel de la Torre.

Measurements: Measurements of holotype (in italics) followed by the mean and extremes of four male and five female paratypes: forearm, 44.3, 44.0 (42.4–45.6); metacarpal III, 42.8, 42.9 (40.7–44.5); metacarpal IV, 43.1, 42.6 (41.5–44.7); metacarpal V, 44.3, 44.1 (42.6–44.9); greatest skull length, 23.4, 23.4 (22.5–23.9); condylobasal length, 21.3, 21.4 (20.3–22.0); zygomatic breadth, 13.5, 13.1 (12.5–13.7); mastoid breadth, 11.7, 11.6 (11.2–12.0); palatal length, 10.1, 10.0 (9.6–10.8); interorbital constriction, 6.5, 6.1 (5.5–6.5); postorbital constriction, 6.5, 5.9 (5.4–6.5); maxillary tooth row, 7.2, 6.9 (6.6–7.2); maxillary width, 8.3, 8.2 (7.7–8.4); mandible, 15.3, 15.2 (14.6–15.5); mandibular tooth row, 7.8, 7.8 (7.6–8.0). Means and extremes of external measurements of the Roseau series (6 specimens) made by the collector, R. F. Klinikowski, follow the measurements of the holotype (in italics): forearm, 43, 43 (42–45); head and body, 65, 64.5 (63–65); hind foot, 13, 13.2 (12–15); ear 14, 15.2 (14–16); tragus, 6, 6.2 (6–7).

Paratypes: Total, 9. DOMINICA, 1 (MCZ), 1 (PM); St. Paul Parish, 6 mi. NE Roseau, 5 (ASFS), 1 (USNM). MARTINIQUE, Morne Rouge, 1 (MCZ).



PROCEEDINGS
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THE NON-MARINE MOLLUSKS OF QUINTANA ROO,
MEXICO WITH THE DESCRIPTION OF A NEW SPECIES
OF *DRYMAEUS* (PULMONATA: BULIMULIDAE)

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The 1960 Bredin-Smithsonian Institution Expedition to the coast of the Territory of Quintana Roo, Mexico, and Grand Cayman was devoted mainly to the collection of marine organisms and insects. Land shells were, however, gathered by the author and other members of the expedition at certain places as the opportunity arose. Since there are only a few scattered published records of non-marine mollusks from Quintana Roo, I have combined these with the recently collected material in the preparation of the following account.

The only paper dealing specifically with the area is H. G. Richards' (1937) publication on the land and freshwater mollusks of Cozumel Island, in which 22 species are listed. Among the material we collected are six species not cited by Richards. In addition, seven other species are listed below which are either mentioned by Bequaert and Clench (1933, 1936) as occurring in Quintana Roo, or are represented by specimens in the collection of the U. S. National Museum, including a representative of a new species. This brings the number of species known to occur in Quintana Roo to 34, a total that will probably be increased by further explorations and collecting.

Many of the new records contained in the Division of Mollusks of the U. S. National Museum are the result of the joint efforts of E. W. Nelson and E. A. Goldman, who over the period 1892 to 1906, covered practically all of Mexico in their explorations, devoting most of their efforts to the investigations of the bird and mammal faunas. In the course of their travels, however, they gathered many mollusks, and in Quintana Roo their collecting was done in three places in the northern part

of the territory—at Puerto Morelos on the mainland, and on the Isla Mujeres and Isle de Cozumel, the former lying to the north of Puerto Morelos, and the latter to the south. A description of the nature of the country and vegetation of this area is given by Goldman in his publication describing these Mexican investigations (Goldman, 1951). More recently, accounts of the geography and physiography of Quintana Roo have been given by Clinton R. Edwards (1954, 1957).

ACKNOWLEDGMENTS

To Dr. William J. Clench, Museum of Comparative Zoology, Harvard University, I am indebted for the privilege of examining certain specimens from Quintana Roo cited in the literature. Dr. R. Tucker Abbott has kindly loaned material from the collection of the Academy of Natural Sciences of Philadelphia for comparison, and from the British Museum, through the cooperation of Messrs. Norman Tebble and S. P. Dance of the Mollusca Section, Department of Zoology, I have obtained photographs of the types of certain species whose status was doubtful.

At this point I would like to express my thanks and appreciation to Mr. and Mrs. Bruce S. Bredin of Wilmington, Delaware, whose sponsorship of numerous expeditions to various parts of the world have immeasurably enriched the collections of the U. S. National Museum, and whose generosity made this trip and my presence on it possible.

COLLECTING STATIONS

Land snails were obtained at seven collecting stations, and the species gathered at these localities are enumerated below.

Sta. 32. Isla de Cozumel: $\frac{1}{2}$ mi. inland from waterfront, on outskirts of San Miguel; under coral rock and debris. 2 April 1960. E. L. Bousfield and F. R. Daiber, collectors.

Helicina (Succincta) arenicola Morelet, 8 specimens
Annularia (Choanopomops) cozumelensis (Richards), many
Lamellaxis micra (Orbigny), 2
Drymaeus cozumelensis Richards, 3
Orthalicus princeps (Broderip), 1 juvenile
Microceramus concisus (Morelet), 14
Streptostyla pilsbryi Richards, 11

Sta. 46. Isla de Cozumel: 2 mi. NE of San Miguel, beyond airfield, $\frac{1}{4}$ mi. E of road; under leaf mold in sink, 5 ft below road level. 8 April 1960. J. F. G. Clarke, collector.

Annularia (Choanopomops) cozumelensis (Richards), 2
Drymaeus cozumelensis Richards, 1
Praticolella griseola (Pfeiffer), 20

Sta. 55. Bahia de Ascension: $\frac{1}{2}$ mi. N of Allen Point, north end of bay; shaken from palmetto fronds. 11 April 1960. J. F. G. Clarke, collector.

Helicina (Tristramia) bocourti Crosse & Fischer, many

Sta. 96. Bahia de Ascension: 300 yards SW of Suleiman Point, north end of bay; on underside of fallen palmetto fronds and on ground beneath. 19 April 1960. H. A. Rehder, collector.

Helicina (Tristramia) bocourti Crosse & Fischer, many

Sta. 98. Tulum: Under stones along base of ruins. 20 April 1960. H. A. Rehder and J. F. G. Clarke, collectors.

Annularia (Choanopomops) largillierti (Pfeiffer), many

Annularia (Choanopomops) cozumelensis (Richards), 3

Gastrocopta pellucida (Pfeiffer), 1

Gastrocopta servilis (Gould), 1

Succinea carmenensis Crosse & Fischer, 5

Microceramus concisus (Morelet), 1

Sta. 113. Isla de Cozumel: Same locality as Sta. 46. 23 April 1960. F. L. Daiber and J. F. G. Clarke, collectors.

Helicina (Succincta) arenicola Morelet,

Annularia (Choanopomops) cozumelensis (Richards), many

Lamellaxis martensi (Pfeiffer), 5

Lamellaxis (Allopeas) gracile (Hutton), 1

Orthalicus princeps (Broderip), 1

Praticolella griseola (Pfeiffer), 7

Sta. 116. Isla de Cozumel: $\frac{1}{4}$ mi. E of waterfront, San Miguel; in cleared and burned-over field, under and among coral rock and wood debris. 29 April 1960. H. A. Rehder, collector.

Helicina (Succincta) arenicola (Morelet), 3

Annularia (Choanopomops) cozumelensis (Richards), 3

Lamellaxis martensi (Pfeiffer), 2

Drymaeus cozumelensis Richards, 4

Streptostyla pilsbryi Richards, 2

ANNOTATED LIST OF SPECIES

The following annotated list includes all the species known to occur within the boundaries of Quintana Roo. To assist future students of the fauna who may wish to use this list as a basis for their work, I have added under each species heading the original citation of the species, and, wherever possible, at least one other reference to a publication with a figure of the species. Unfortunately, many of the species are not described and figured in recent and readily available malacological works. In addition, I have given all references where mention is made of an occurrence of a species in Quintana Roo.

Family HELICINIDAE

Genus *HELICINA* Lamarck, 1799Subgenus *SUCCINCTA* Wagner, 1905*Helicina (Succincta) arenicola* Morelet, 1849

Helicina arenicola Morelet, 1849, p. 21.—Fischer & Crosse, 1893, p. 424–425, pl. 56, Figs. 8, 8a–c.—Wagner, 1910, p. 316, pl. 63, Figs. 11–13.—Richards, 1937, p. 257.

This species is fairly well distributed over much of the northern part of the Yucatán Peninsula. From Quintana Roo we have seen specimens from Chancanab, Lake Chichankanab near Esmeralda, and Tulum. We collected it at several places near San Miguel, Isla de Cozumel, and Richards records it also from San Gerbacio on the same island.

Subgenus *TRISTRAMIA* Crosse, 1862*Helicina (Tristramia) bocourti* Crosse & Fischer, 1869

Figs. 8–10, 18–20

Helicina Bocourti Crosse & Fischer, 1869, p. 251.

Helicina Dysoni var. *Bocourti* Fischer & Crosse, 1893, p. 437–438, pl. 56, Fig. 10.

Helicina dysoni var. *jansoni* Martens, 1890, p. 40, pl. 1, Fig. 18.

This species, found by us in two localities at the northern end of Bahia de Ascension, has apparently not been recorded previously from north of Belize, British Honduras, the type-locality. I have examined specimens of this species, now in the collections of the Academy of Natural Sciences, Philadelphia, collected by R. Robertson, at various places along the coast of British Honduras, from Rocky Point, at the northern tip, to Port Honduras, near the Guatemala border.

The specimens of *Helicina dysoni* listed as occurring on Utila Island, Honduras by Ancey (1886, pp. 255–256), and the variety *jansoni* Martens (1890, p. 40) from Bonacca Island, Honduras (now known as Isla Guanaja), listed by Richards (1938, p. 174) as occurring also on the neighboring Isla Roatan, should all be referred to *H. bocourti*.

Martens' separation of his variety *jansoni* on the basis of its being more angulate than *bocourti* is difficult to understand if one examines his figure of this variety, which shows a shell less angulate and flattened than Fischer and Crosse's figure of the typical form.

The geographic range of *H. bocourti*, therefore, extends from Bahia de Ascension, midway on the coast of Quintana Roo, along the coast of British Honduras, to Isla Guanaja, at the midpoint of the coast of Honduras.

H. B. Baker (1922, p. 47) was not sure that *bocourti* and *jansoni*, considered by Pfeiffer (1852, p. 384), Martens (1890, p. 40), and Fischer & Crosse (1893, p. 437) to be subspecies or varieties of *Helicina*

dysoni, were related to *H. dysoni*. An examination of the radula of one of the specimens we collected (Figs. 18–19) shows that *H. dysoni* belongs in the subgenus *Tristramia*, of *Helicina*, rather than in the genus *Alcadia*, where many workers have placed it.

Helicina dysoni Pfeiffer (1849, p. 121), described originally from "Cumana, Honduras," was designated by H. B. Baker (1922, p. 47) as type of the section *Analcadia* A. J. Wagner, 1907. I have figured a syntype of *Helicina dysoni* (Figs. 11–13), bearing the BM (NH) Reg. no. 196283, that I here designate as the lectotype. This specimen closely matches specimens in the U. S. National Museum collection from the State of Sucre, Venezuela, and from the neighboring island of Margarita. The Venezuelan specimens show a rounded body whorl, not angulate as in *bocourti*, with the surface bearing periostracal hairs, and an operculum that shows the greater calcification characteristic of the genus *Alcadia*, as opposed to the largely horny, red-colored operculum, calcified only near the columellar edge, usually found in *Helicina*. For purposes of comparison I have figured specimens of *bocourti* from Bahia de Ascension (Figs. 8–10).

It is well known that Dyson collected in Venezuela as well as in Honduras (Hewitson, 1848, p. 117), and since *Alcadia dysoni* seems to be restricted to Venezuela and the neighboring islands, I assume that the locality cited in the original description is partly erroneous, and should read "Cumana, Venezuela."

Helicina diaphana Pfeiffer, described from Honduras, and listed by H. B. Baker (1922, p. 47) with some doubt as a subspecies of *dysoni*, is distinct from both *bocourti* and *dysoni*, according to a photograph of a syntype of *H. diaphana* in my possession. The figures for this species given by Sowerby (1866, pl. 275, Fig. 41; 1873, pl. 28, Fig. 251) show a shell that is too strongly angulated, a fact that undoubtedly led Baker to ally *diaphana* with *bocourti*.

From a comparison of the radular characters with those depicted by H. B. Baker (1922, pl. 3, 4), *Helicina bocourti* seems to belong in the subgenus *Tristramia*, but I am not certain that radular characters alone can be used for subgeneric differentiation. In the radula of *H. bocourti* (Fig. 18–19) the centrals have the characters of the *Oxyrhombus* group, while what Baker calls the capituliform complex appears to combine the characters of both *Oxyrhombus* and *Tristramia*, the comb-lateral being more like that found in *Oxyrhombus*, while the accessory plate resembles that in the radula of *Tristramia*. To clarify these comparisons I have copied (Figs. 14–17) the radula figures for *Tristramia* and *Oxyrhombus* groups from Baker (1922, pl. 3, Figs. 8, 9; pl. 4, Figs. 13, 15). Baker first (1922, pp. 48–51) placed *Oxyrhombus* and *Tristramia* as sections under *Helicina*, subgenus *Tristramia*, but later (1926, p. 42) recognized both of these groups as distinct subgenera. On the basis of the radular characters I synonymize *Oxyrhombus* and *Tristramia* and use the older name *Tristramia* as the subgenus for *bocourti*.

Family CYCLOPHORIDAE

Genus *NEOCYCLOTUS* Fischer & Crosse, 1886

Neocyclotus dysoni berendti (Pfeiffer, 1861)

Cyclotus (?) *Berendti* Pfeiffer, 1861, p. 171.

Neocyclotus Berendti Fischer & Crosse, 1886, p. 167, pl. 38, Figs. 4-5.

Poteria (Neocyclotus) berendti Bequaert & Clench, 1933, p. 540.

Aperostoma (Neocyclotus) dysoni berendti Bartsch & Morrison, 1942, p. 212, pl. 29, Figs. 4-6.

Four specimens collected 12 km from Icaiche by A. Dampf belong to this subspecies, which is not uncommon in the State of Yucatán.

Family PILIDAE

Genus *POMACEA* Perry, 1811

Pomacea flagellata (Say, 1829)

Ampullaria flagellata Say, 1829, p. 260.—Marten, 1899, p. 405, pl. 23, Figs. 1, 4, 4a-b.

Pomacea violacea Bequaert & Clench, 1933, p. 543.

This species has been divided into numerous subspecies and varieties by several authors, based largely on shape of shell and superficial sculpture and color. I have seen two lots of this species from Quintana Roo, one from Lake Chichancanab, in the northwest corner of the territory, and the other from 12 km from Icaiche, in the southwest corner. These lots show considerable variation in form and color, and cast some doubt on the validity of most of the named subspecies of this variable Mexican and Central American species.

Family POMATIASIDAE

Genus *ANNULARIA* Schumacher, 1817

The name *Choanopoma* Pfeiffer, 1847 has been used for this genus by numerous writers for many years instead of the earlier name *Annularia*, because of doubts concerning the validity of Dall's type designation for *Annularia*. Dall (1905, p. 208) designated as type of Schumacher's genus *Turbo lincina* Linnaeus, a name that Schumacher cited as synonym of his species *Annularia fimbriata*; in addition, he referred to a figure of *Turbo lincina* in Chemnitz (1786, pl. 123, Fig. 1060).

The claim that the *Turbo lincina* in Schumacher is not *Turbo lincina* Linnaeus and that, therefore, the type designation is not valid is irrelevant, for Linnaeus' species as a synonym is available as a type-species, regardless of Schumacher's concept of that species.

Aguiayo (1934, p. 135) has shown that *Turbo lincina* Linnaeus, the type-species of both *Annularia* and *Choanopoma*, can be identified with a Jamaican species.

The use of *Annularia*, as exemplified by Wenz (1939, p. 548) should be followed if we are to adhere to the International Code of Zoological Nomenclature.

Subgenus *CHOANOPOMOPS* H. B. Baker, 1928

Annularia (*Choanopomops*) *largillierti* (Pfeiffer, 1846)

Cyclostoma Largillierti Pfeiffer, 1846B, p. 46.

Cistula Largillierti Fischer & Crosse, 1890, p. 196, pl. 42, Figs. 10, 10a-b.

Choanopoma (*Choanopomops*) *largillierti* Solem, 1961, p. 200, pl. 12, Figs. 24j-k.

The abundant presence of this species around the base of some of the crumbling buildings of the ruins of Tulum, on the mainland, almost opposite the southern end of Isla de Cozumel, makes it appear likely that it may be found elsewhere along this coast, and thus tie together the Yucatán records of this species with that of Chetumal (Solem, 1961, p. 200) near the border of British Honduras.

Annularia (*Choanopomops*) *cozumelensis* (Richards, 1937)

Choanopoma cozumelensis Richards, 1937, p. 256, pl. 4, Fig. 3.

Choanopoma (*Choanopomops*) *cozumelensis* Solem, 1961, p. 198, pl. 10, Fig. 7; pl. 12, Fig. 24g.

According to Solem this species is known only from Isla de Cozumel, where we collected it in several places. However, I also found three specimens at Tulum, among specimens of the more common *A. largillierti* (Pfeiffer). *A. cozumelensis*, therefore, like *largillierti*, may be found to occur elsewhere along the coast.

Family PHYSIDAE

Genus *STENOPHYSA* Martens, 1898

Martens (1898, p. 362) proposed *Stenophysa* as a subgenus of *Physa*, including in it a number of species that Fischer & Crosse (1886, pp. 85-95) had placed in the genus *Aplexa*, whose type-species is the boreal *A. hypnorum* Linnaeus. The type-species of Martens' new subgenus, the West Indian *Physa sowerbyana* (= *Stenophysa rivalis* Maton & Rackett), agrees with *S. spiculata* in having the right, or columellar, margin of the mantle edge scalloped and furnished with pigment spots. The other Mexican and Middle American species that resemble *S. spiculata* in shell characters were distributed by Martens (*l.c.*) among the subgenera *Aplexa* and *Stenophysa* depending on the color and form of the shell, and the nature of the columellar margin of the aperture. These shell characters are in my opinion too plastic and variable to be used to differentiate these two taxa, and until the mantle character of each of these neotropical species is examined, I believe that they should all be assigned to *Stenophysa*. I am raising *Stenophysa* to generic rank on the basis of the character of the mantle edges and because of the distinct geographic areas inhabited by it and *Aplexa*.

Stenophysa spiculata (Morelet, 1849)

Physa spiculata Morelet, 1849, p. 18.

Physa cisternina Morelet, 1851, p. 15.

Aplecta spiculata Fischer & Crosse, 1886, p. 93, pl. 27, Figs. 13-13b.

Aplexa spiculata Bequaert & Clench, 1936, pp. 69-70, pl. 2, Figs. 1-4.—
Richards, 1937, p. 256.

This species inhabits Campeche, Yucatán, Quintana Roo, British Honduras, and northern Guatemala.

Stenophysa princeps (Phillips, 1846)

Physa princeps Phillips, 1846, p. 66-67, pl. 1, Fig. 11.

Aplexa princeps Bequaert & Clench, 1936, p. 68, pl. 1, Figs. 5-6.

?*Aplexa maugeriae* Bequaert & Clench, 1936, p. 69.

The geographic range of this species, recorded by Bequaert and Clench (1933, p. 539; 1936, pp. 68-69) from Yucatán and from the Rio Hondo, on the boundary between Quintana Roo and British Honduras, extends apparently from the state of Tabasco, Mexico, to northern Guatemala. A lot collected at Puerto Morelos, Quintana Roo, by Nelson and Goodman, consists of specimens varying considerably in shape of shell and aperture and in form of the columella. Because of this variability the specimens from Tabasco, Yucatán, and northern Guatemala, identified by Bequaert and Clench (1936, p. 69) as *Aplexa maugeriae* (Sowerby), are probably this species.

Family PLANORBIDAE

Genus *DREPANOTREMA* Crosse & Fischer, 1880

Subgenus *FOSSULORBIS* Pilsbry, 1934

Drepanotrema (*Fossulorbis*) *kermatoides* (Orbigny, 1835)

Planorbis kermatoides Orbigny, 1835, p. 27.

Planorbis cultratus Orbigny, 1841, p. 196, pl. 14, Figs. 5-8.

Drepanotrema cultratum Richards, 1937, p. 255.

This species was found by Richards in association with the other three species of this family on the Isla de Cozumel.

Subgenus *ANTILLORBIS* Harry & Hubendick, 1964

Drepanotrema (*Antillorbis*) *aeruginosus* (Morelet, 1851)

Planorbis aeruginosus Morelet, 1851, p. 15.

Planorbis circumlineatus Shuttleworth, 1854, p. 96-97.

Gyraulus arizonensis Richards, 1937, p. 255 (not Pilsbry & Ferris, 1915).

—Branson, 1963, p. 51-52 (in part).

Two lots of this species, collected by H. G. Richards on Isla de Cozumel, were identified by him as *Gyraulus arizonensis* Pilsbry and Ferris. As the presence of a Sonoran species in the coastal area of Yucatán seemed an anomaly, I requested the loan of this material. J. P. E. Morrison identified Richards' specimens as *D. aeruginosa*. The

nomenclature and distribution of *D. aeruginosa* is discussed by Harry and Hubendick (1964, pp. 32–33).

Genus *ARMIGERUS* Clessin, 1884

A strict interpretation of the International Code of Zoological Nomenclature forces us to follow Morrison (1947, p. 30–31) in his use of this name. The divergent views of H. J. Walter (1963, p. 92) and C. A. Wright (1962, p. 39; 1963, p. 98) on the morphology of this and allied genera, seems to point to the need for further anatomical work. Until this is forthcoming, I am inclined to consider this genus as distinct from *Taphius*.

Armigerus obstructus (Morelet, 1849)

Planorbis obstructus Morelet, 1849, p. 17.

Planorbula obstructa Fischer & Crosse, 1880, p. 78, pl. 33, Figs. 8–8d; pl. 34, Figs. 7–7d.—Richards, 1937, p. 255.

Tropicorbis (Obstructio) obstructus F. C. Baker, 1945, p. 85, pl. 128, Figs. 26–33; pl. 133, Figs. 28–35.

This rather widely spread species was recorded by Richards as occurring in a dried swamp, a short distance north of San Miguel, Isla de Cozumel.

Subgenus *TROPICORBIS* Pilsbry & Brown, 1914

Armigerus (Tropicorbis) orbiculus (Morelet, 1849)

Planorbis orbiculus Morelet, 1849, p. 17.—Fischer & Crosse, 1880, p. 70, pl. 32, Figs. 9–9c.—Richards, 1937, p. 255.

Tropicorbis orbiculus F. C. Baker, 1945, p. 85, pl. 129, Figs. 1–3, 5–7, 10–16.

Richards found this species in dried swamps north of San Miguel, and near San Gerbacio, Isla de Cozumel.

Family GASTROCOPTIDAE

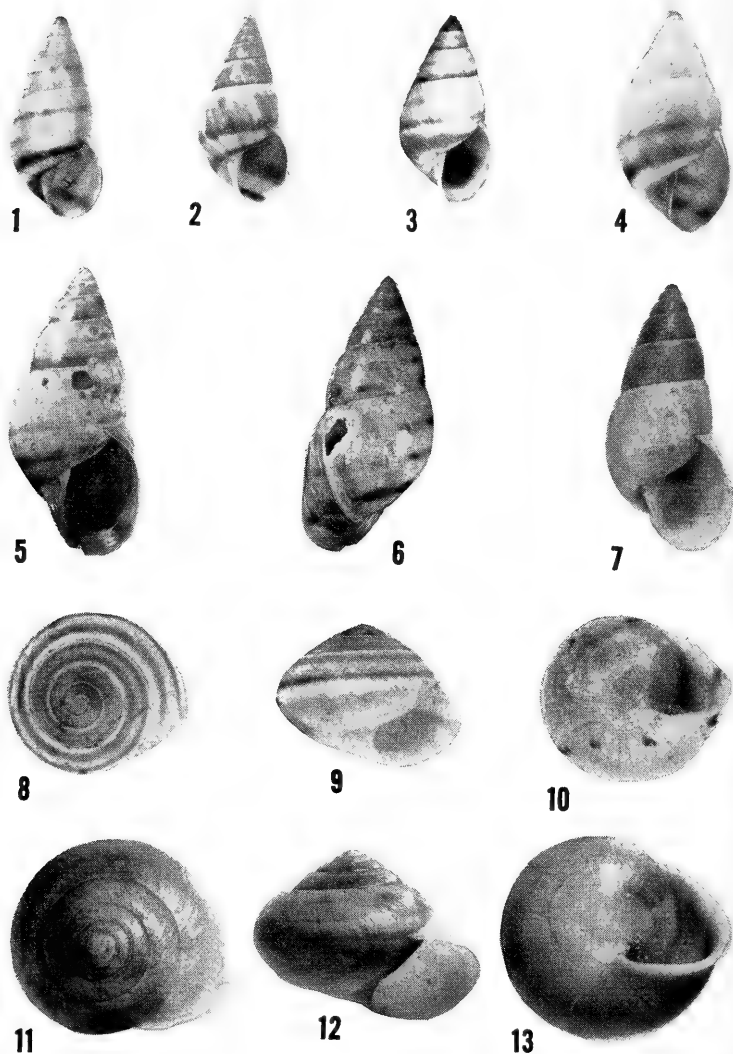
This family name replaces Chondrinidae as used by Zilch (1959, p. 156) and Taylor and Sohl (1962, p. 11), since the generic name *Chondrina* Reichenbach, 1828 on which the family name is based, is a synonym of *Chondrus* Cuvier, 1817, a member of the family Enidae. *Chondrina* was proposed as a substitute for *Chondrus* Cuvier, erroneously believed to be preoccupied by *Chondrus* Stackhouse, 1797, a genus of algae. *Chondrina*, therefore, has the same type-species as *Chondrus* Cuvier, and becomes a synonym. *Chondrina s.l.* of authors becomes *Modicella* H. & A. Adams, 1855, and the restricted *Chondrina* of authors is replaced by *Alloglossa* Lindström, 1868.

Gastrocoptidae is, furthermore, the oldest family name for this group, having been used by Pilsbry in 1918 as a subfamily.

Genus *GASTROCOPTA* Wollaston, 1878

Gastrocopta pellucida (Pfeiffer, 1841)

Pupa pellucida Pfeiffer, 1841, p. 466.



FIGS. 1-13. 1, *Drymaeus shattucki* Bequaert & Clench, holotype. 2, *Drymaeus* sp., (Progreso, Yucatan), 3-4, *D. mayaorum* Rehder, 3, paratype; 4, holotype. 5-6, *D. hondurasanus* (Pfeiffer). 7, *D. cozumelensis* Richards. 8-10, *Helicina bocourti* Crosse & Fischer. 11-13, *Alcadia dysoni* (Pfeiffer).

Gastrocopta pellucida Pilsbry, 1916, p. 75, pl. 15, Figs. 1-3, 5.

This species has been recorded from Yucatán by Fischer & Crosse (1873, p. 312) and Harry (1950, p. 22). Because these workers considered *G. servilis* (Gould) to be a synonym of *pellucida* their records cannot be definitely assigned to either species. This and the following species are rare in Yucatan as Bequaert and Clench (1933; 1936; 1938) did not find them among the collections from Yucatán submitted to them. We found only one specimen at Tulum.

Gastrocopta servilis (Gould, 1843)

Pupa servilis Gould, 1843, p. 356, pl. 16, Fig. 14.

Gastrocopta servilis Pilsbry, 1916, p. 70.

This species is much more widely spread than the preceding one, and its occurrence in Quintana Roo is not unexpected in view of its having been recorded from the states of Vera Cruz, Campeche, and Yucatán, in Mexico, and from northern Guatemala and Panama. We found only one specimen at Tulum.

Family SUCCINEIDAE

Genus *SUCCINEA* Draparnaud, 1801

Succinea carmenensis Fischer & Crosse, 1878

Succinea undulata var. *carmenensis* Fischer & Crosse, 1878, p. 657, pl. 27, Figs. 6, 6a.

Succinea carmenensis Richards, 1937, p. 255, pl. 4, Fig. 5.

This species, originally described from Isla del Carmen, Campeche, was found by Richards on the Isla de Cozumel, and by us about the ruins of Tulum on the mainland. In addition, a specimen collected on the Isla de Cozumel on 29 January 1885 by the U. S. Fish Commission is in the U. S. National Museum collection. Bequaert and Clench (1933, p. 537) record *S. carmenensis* from several intermediate localities in Yucatán.

Family SUBULINIDAE

Genus *LAMELLAXIS* Strebel & Pfeiffer, 1882

Subgenus *LAMELLAXIS* s.s.

Lamellaxis (Lamellaxis) martensi Pfeiffer, 1856

Bulimus Martensi Pfeiffer, 1856, p. 318.

Spiraxis Martensi Fischer & Crosse, 1877, p. 619, pl. 25, Figs. 9, 9b.

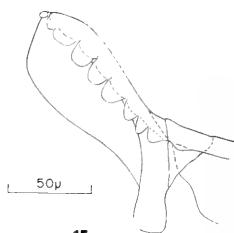
Leptinaria martensi Pilsbry, 1907, p. 308, pl. 41, Fig. 68.

Lamilaxis [sic] martensi Richards, 1937, p. 254, pl. 4, Fig. 1.

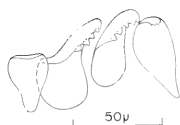
This species, recorded by Richards from near San Miguel and San Gerbacio on the Isla de Cozumel, was found by us also at the former locality.



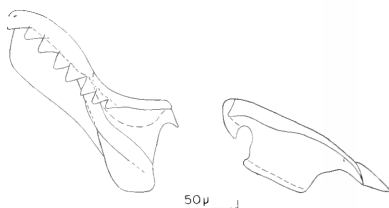
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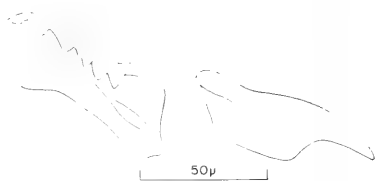
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FIGS. 14–19. 14, *Helicina (Tristramia) zephyrina* Duclos. Central complex of radula; rachidian and A, B, and C centrals (after Baker, 1926). 15, *Helicina (Tristramia) zephyrina* Duclos. Capitulum complex of radula: comb-lateral and inner end of accessory plate (after Baker, 1926). 16, *Helicina (Oxyrhombus) amoena* Pfr. Central complex (as in Fig. 14) (after Baker, 1926). 17, *Helicina (Oxyrhombus) amoena* Pfr. capitulum complex: comb-lateral and accessory plate (after Baker, 1926). 18, *Helicina (Oxyrhombus) bocourti* Cr. & Fischer. Central complex. 19, *Helicina (Oxyrhombus) bocourti* Cr. & Fischer. Capitulum complex.

Lamellaxis (Lamellaxis) micra (Orbigny, 1835)

Helix micra Orbigny, 1835, p. 9.

Bulimus micra Orbigny, 1837, p. 262, pl. 41, Figs. 18–20.

Opeas costatostriatus Fischer & Crosse, 1877, p. 598, pl. 26, Figs. 5–5b.
not *costatostriatus* Pfeiffer, 1856).

Opeas octonoides Martens, 1898, p. 293, pl. 17, Fig. 9.

Opeas micra Pilsbry, 1906, p. 193, pl. 27, Figs. 49, 56–57.

Lamillaxis [sic] micra Richards, 1937, p. 254.

This species, widely distributed throughout tropical America, was found near San Miguel, Isla de Cozumel, both by Richards and during the Bredin-Smithsonian Institution Expedition.

Subgenus *ALLOPEAS* H. B. Baker, 1935*Lamellaxis (Allopeas) gracilis* (Hutton, 1834)

Bulimus gracilis Hutton, 1834, p. 93.

Opeas gracile Pilsbry, 1906, p. 125, pl. 18, Figs. 3–6.

Lamellaxis (Allopeas) gracilis Baker, 1945, p. 88.

One specimen of this species, widely spread in the tropical parts of the world, was found near San Miguel, Isla de Cozumel.

Family BULIMULIDAE

Genus *BULIMULUS* Leach, 1814*Bulimulus sanmiguelensis* Richards, 1937

Bulimulus sanmiguelensis Richards, 1937, p. 253, pl. 4, Fig. 6.

This species, found by Richards in some numbers near San Miguel, Isla de Cozumel, was not collected by us. In shape of shell it is closer to *Bulimulus dysoni* (Pfeiffer), described from Honduras, than to *B. unicolor* (Sowerby), to which Richards compared it.

Genus *DRYMAEUS* Albers, 1850*Drymaeus cozumelensis* Richards, 1937

Fig. 7

Drymaeus cozumelensis Richards, 1937, p. 253, pl. 4, Fig. 4.

Drymaeus serperastrus Branson and McCoy, 1963, p. 106 (in part).

The examination of a large series of specimens of this species and of *Drymaeus shattucki* Bequaert and Clench, has led me to the conclusion that *D. cozumelensis* is a distinct species rather than a subspecies of *shattucki*, as Richards considered it. Branson and McCoy (1963, p. 106) are also inclined toward this view.

D. cozumelensis is generally larger than *D. shattucki*, with an outer lip that is noticeably expanded and with the inner lip rather broadly reflected over the moderately wide umbilicus. The color is usually pure white with apex and umbilical area pinkish brown to coral pink, and the columellar portion of the lip is also tinted but usually more faintly.

Some specimens show banding, the pattern consisting of five interrupted bands of varying width, similar to that found in *D. shattucki*. Two out of five specimens collected by C. J. McCoy 3 km S of San Miguel and kindly loaned to me by him show this distinct banding. These are the specimens that were called *D. serperastrus* by Branson and McCoy (1963, p. 106). Some specimens have the last whorl of a straw-yellow color, with the yellow color apparent also within the aperture. The species is apparently restricted to the Isla de Cozumel.

Drymaeus shattucki (Fig. 1) is smaller than *cozumelensis*, with the outer lip unexpanded, and the inner lip fairly narrowly reflected over the smaller umbilicus. The specimens vary in color from pure white to possessing four bands as in the holotype figured here. The inner lip is always uncolored and the apex is usually without color, although in the holotype it is light straw-colored, and in this respect exactly like the nuclear whorls of the holotype of *D. cozumelensis*. *Drymaeus shattucki* is found from Oxtutzcab and Chichén Itzá in Yucatán south into the Petén district of northern Guatemala (Goodrich and van der Schalie, 1937, p. 28).

The specimen from Progreso, Yucatan, mentioned by Bequaert and Clench (1933, p. 533), and which I have figured (Fig. 2), seems to represent another species, as it is without the microscopic spiral grooves found in all the other shells, has a noticeably expanded lip, and has only two bands—peripheral and subperipheral. I hesitate to describe this as a new species on the basis of only one specimen, well-marked as it may be. Further collecting needs to be done in the region about Progreso and the coastal area of Yucatán.

We found *D. cozumelensis* in several places near San Miguel, Isla de Cozumel. Two of the specimens show the yellow coloration mentioned by Richards in his original description.

Drymaeus hondurasanus (Pfeiffer, 1846)

Figs. 5–6

Bulimus Hondurasanus Pfeiffer, 1846, p. 29.

Drymaeus hondurasanus Pilsbry, 1899, p. 88, pl. 15, Fig. 41.

Because Bequaert and Clench (1933, p. 533) suggest that *D. shattucki* may be referable to *D. hondurasanus*, a species that is not known to occur in Quintana Roo, I obtained a photograph, which I reproduce here, of a specimen labeled as a syntype of *Drymaeus hondurasanus* (Pfeiffer) and which I am here designating as the lectotype of this species. This specimen, collected on the leaves of bushes by Dyson, measures 28.5 mm high and 13 mm wide, considerably greater than the dimensions given by Pfeiffer in his original description.

It is obviously quite different from *D. shattucki*, and also does not appear to be related to *D. alternans* Beck, as Martens suggested (1890–91, p. 232). The terrestrial mollusks of Honduras are very poorly known, and this species may be rediscovered there.

Drymaeus mayaorum, new species

Figs. 3-4

Drymaeus shattucki Richards, 1937, p. 253 (not *shattucki* Bequaert & Clench, 1933).

Diagnosis: Shell rather broadly elongate-conic, white with bands of isabelline or buffy brown which may have irregular, interrupted spots of darker brown. Apical whorls dark-colored and umbilical area straw-colored. Lip thin, simple at the columella, strongly and narrowly reflected over the narrow umbilicus.

Range: Isla Mujeres and Isla de Cozumel, off the coast of Quintana Roo, Mexico.

Description: Shell moderately broadly elongate conic, 19.8-23.3 mm in height, narrowly umbilicate, moderately thin; $6\frac{1}{2}$ whorls, only slightly convex, suture moderately impressed. Color white, with four bands of isabelline and buffy brown on the last whorl, the peripheral band and the one midway between the periphery and the suture narrow, the one between the periphery and the umbilicus, and the one spotting the umbilical area broader; in the holotype the uppermost band is obscure and the peripheral and subperipheral bands are irregularly marked with splotches of darker chestnut brown. The apex is dark-colored. The sculpture consists of very fine, rather wavy and fairly crowded, incised lines, with the nuclear whorls showing the typical *Drymaeus* grated sculpture. Aperture moderately broadly oval, with the outer lip simple, and the inner, columellar lip narrowly reflected over the umbilicus.

Holotype (U.S.N.M. 251656): Isla Mujeres, Quintana Roo, Mexico, collected by E. W. Nelson and E. A. Goldman, 25 March 1901 (Fig. 4). Measurements: height, 23.3 mm; width, 12.0 mm.

Paratype (A.N.S.P. 167664): Near San Miguel, Isla de Cozumel, Quintana Roo, Mexico, collected by H. G. Richards, 1936 (Fig. 3). Measurements: height, 19.8 mm; width, 10.0 mm.

Remarks: This species differs from *D. cozumelensis* Richards in being smaller, more conic, conspicuously banded, with an unexpanded outer lip. From *D. shattucki* Bequaert and Clench it differs in being broader, more conical, with tinted nucleus and umbilical area, and with a broader aperture. The color pattern resembles that of some of the forms of *D. emeus* (Say) but that species is more elongate-ovate in outline and not as broadly conic as is *D. mayaorum*.

The paratype is the specimen that Richards (1937, p. 253) identified as *Drymaeus shattucki*, to which species *D. mayaorum* is probably most closely related.

Family ORTHALICIDAE

Genus *ORTHALICUS* Beck, 1837*Orthalicus princeps* (Sowerby, 1833)

Bulinus princeps 'Broderip' Sowerby, 1833, pl. 27, Fig. 18, p. 6.

Orthalicus princeps Fischer & Crosse, p. 455, pl. 18, Figs. 2, 2a.

Ortalicus princeps Martens, 1893, p. 182, pl. 10, Figs. 3-6.

Oxystyla princeps Pilsbry, 1899, p. 113, pl. 16, Figs. 1-9.—Richards, 1937, p. 253.

Two freshly dead specimens of this species were found on the eastern outskirts of San Miguel, Isla de Cozumel, and two miles NE of that town. Richards found several dead shells near the beach on the west side of the island, and McCoy collected living specimens on fig trees south of San Miguel (Branson and McCoy, 1963, p. 107).

Family UROCOPTIDAE

Genus *BRACHYPODELLA* Beck, 1837

Brachypodella speluncae (Pfeiffer, 1852)

Cylindrella speluncae Pfeiffer, 1852, p. 151.—Fischer & Crosse, 1873, p. 410, pl. 17, Figs. 11-11b.

Brachypodella speluncae Pilsbry, 1903, p. 69, pl. 6, Figs. 13-14, 17-18.—Richards, 1937, p. 254.

This species, of which Richards found specimens in two localities on Isla de Cozumel, is found on the mainland in Yucatán and northern Guatemala.

Genus *MICROCERAMUS* Pilsbry & Vanatta, 1898

Microceramus concisus (Morelet, 1849)

Cylindrella concisa Morelet, 1849, p. 12.

Macroceramus concisus Fischer & Crosse, 1873, p. 421, pl. 18, Figs. 1-1b.

Microceramus concisus Pilsbry, 1904, p. 155, pl. 25, Figs. 7-12.—Richards, 1937, p. 254.

This species, with a range similar to that of the preceding species, was found also in two localities on Isla de Cozumel by Richards. In 1960 we found it on the outskirts of San Miguel, Isla de Cozumel, and also at the ruins of Tulum on the mainland.

Family EUCONULIDAE

Genus *GUPPYA* Mörch, 1867

Guppya gundlachi (Pfeiffer, 1840)

Helix gundlachi Pfeiffer, 1840, p. 250.

Guppya gundlachi Richards, 1937, p. 252.—Pilsbry, 1946, p. 244, Fig. 120.

This widely distributed species, ranging from Florida and Texas to Venezuela and Trinidad and throughout the West Indies, was collected near San Miguel, Isla de Cozumel.

Family THYSANOPHORIDAE

Genus *THYSANOPHORA* Strebel & Pfeiffer, 1880Subgenus *LYROCONUS* H. B. Baker, 1927*Thysanophora (Lyroconus) plagioptycha* (Shuttleworth, 1854)*Helix plagioptycha* Shuttleworth, 1854, p. 37.*Thysanophora plagioptycha* Richards, 1937, p. 252.*Thysanophora (Lyroconus) plagioptycha* Pilsbry, 1940, p. 989, Fig. 576.

This species, found in the West Indies and from eastern Mexico to Trinidad and Venezuela, was found near San Miguel, Isla de Cozumel, by Richards.

Thysanophora (Lyroconus) caecoides (Tate, 1870)*Helix caecoides* Tate, 1870, p. 155, pl. 16, Fig. 2.*Thysanophora caecoides* Pilsbry, 1920, p. 95-96, Fig. 4.—Richards, 1937, p. 252.

Richards found this species, whose range extends from Vera Cruz, Mexico, to Panama, with the preceding species on Isla de Cozumel.

Family POLYGYRIDAE

Genus *POLYGYRA* Say, 1818*Polygyra cereolus* (Muhlfeld), form *carpenteriana* (Bland, 1860)*Helix Carpenteriana* Bland, 1860, p. 138.*Polygyra cereolus carpenteriana* Bequaert & Clench, 1933, p. 531.*Polygyra cereolus* form *carpenteriana* Pilsbry, 1940, p. 585, Figs. 379i-k.

Bequaert and Clench record this form from Progreso, Yucatán, and Puerto Morelos, Quintana Roo. It has been collected on Isla Mujeres by Nelson and Goldman, who also gathered the specimens from Puerto Morelos. I have examined both of these lots, and although Bartsch had separated them specifically in manuscript, I cannot distinguish them from Floridan specimens.

Subgenus *ERYMODON* Pilsbry, 1956*Polygyra (Erymodon) yucatanica* (Morelet, 1849)*Helix yucatanica* Morelet, 1849, p. 9.*Helix (Polygyra) Yucatanica* Fischer & Crosse, 1872, p. 277, pl. 12, Figs. 14, 14a.*Polygyra yucatanica* Bequaert & Clench, 1933, p. 531.

This species, originally described from specimens from the Isla del Carmen in Campeche and from the State of Tabasco, is found in the area stretching across the base of the Yucatán peninsula. Bequaert and Clench record it from San Juan Bautista (now known as Villahermosa) in Tabasco, and from Icaiche in the southwestern corner of Quintana Roo; in between it is not rare in the Petén district of Guatemala (Goodrich and van der Schalie, 1937, p. 27).

Genus *PRATICOLELLA* Martens, 1892*Praticolella griseola* (Pfeiffer, 1841)

Fig. 20

Helix griseola Pfeiffer, 1841, p. 41.*Helix (Praticolella) berlandieriana* var. *griseola* Martens, 1892, p. 140, pl. 7, Figs. 15-17.*Praticolella griseola* Pilsbry, 1940, p. 690, Fig. 425.

The specimens from Isla de Cozumel resemble those from Campeche and Chichén Itzá, Yucatán. They differ from those found in the state of Vera Cruz in having a more flattened shape, with the whorls of the spire more convex, and with a wider umbilicus. In addition, an axially oriented pattern of irregularly alternating white opaque and darker translucent patches noticeably dominates the spiral bands which are more strongly marked in the specimens from Vera Cruz.

In an attempt to elucidate the status of the populations of *P. griseola*, a distributional map (Fig. 20) has been made of the specimens of the two common species of *Praticolella*, *berlandieriana* (Moricand) and *griseola* (Pfeiffer), that I have examined. This map is based on the specimens in the collection of the U. S. National Museum, and on reliable references in the literature. Though examination of specimens in other collections may alter somewhat the distributional pattern presented in this map, nevertheless several interesting facts are indicated.

One is that *P. griseola* and *berlandieriana* inhabit, with one exception, non-overlapping territories, that approach each other at only one point. The exception is the rather distinct Brownsville, Texas, population of *griseola* that lives well within the territory of *P. berlandieriana*.

The other fact is that *P. griseola* consists of a number of more or less well-characterized races. One is the Brownsville, Texas race, composed of rather large specimens with sharply defined color bands. The Yucatán race has already been briefly described above. I have seen no specimens of the race from the Lake Petén area in Guatemala (Goodrich & van der Schalie, 1937, p. 27), and am unable to determine whether it resembles the Yucatán race, or whether the shells have a distinct aspect.

The Nicaraguan specimens from Isla Omotepe in Lake Nicaragua are generally thin-shelled, usually somewhat smaller and more elevated than the Mexican specimens, darker in color, and with no bands on the base, except occasionally a band in the umbilical area. The specimens from Momotombo, on the northern end of Lake Managua, are large, also thin, with the spiral coloration reduced or absent, giving them a dark, fragile appearance.

An interesting problem awaits the student of neotropical land snails who will undertake a study of the genus *Praticolella*. Further collecting in the intervening areas between the territories of the races as shown on the map may uncover new records. A careful study of large series of shells, and an examination of the soft parts of specimens of the various races should reveal whether these races are deserving of subspecific rank, parallel to the several Texan races of *P. berlandieriana*.

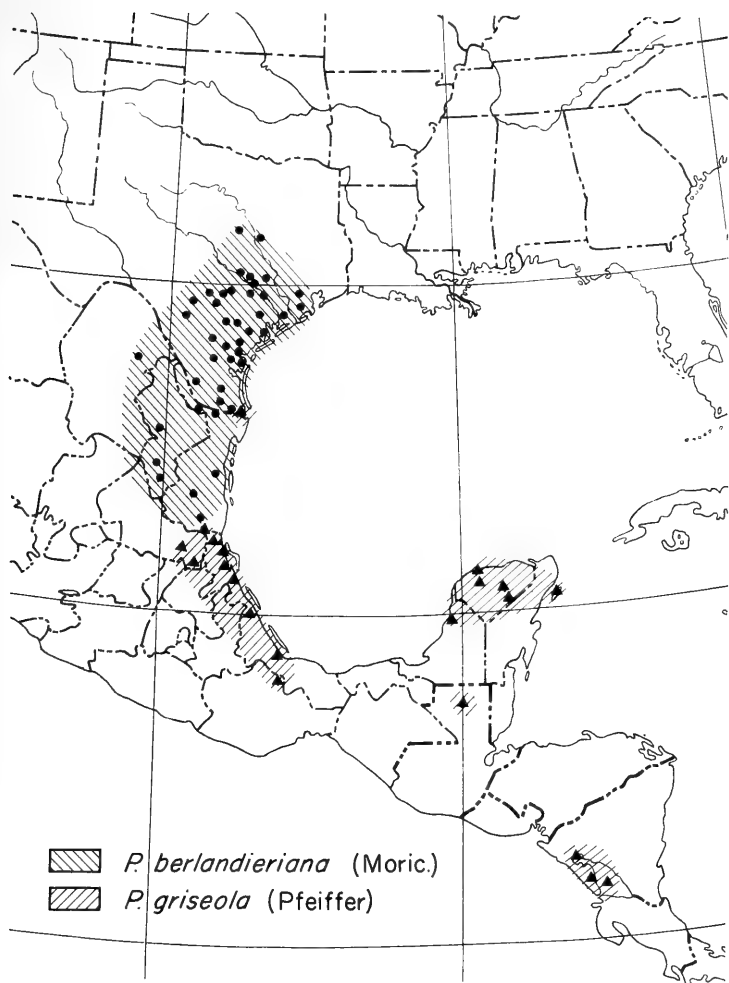


FIG. 20. Map showing distribution of *Praticolella berlandieriana* and *P. griseola* in Texas, Mexico and Central America.

Family OLEACINIDAE

Genus *STREPTOSTYLA* Shuttleworth, 1852

Streptostyla pilsbryi Richards, 1937

Streptostyla pilsbryi Richards, 1937, p. 252, pl. 4, Fig. 2.

This species, described by Richards from near San Gervacio, Isla de Cozumel, was found by us in some numbers near San Miguel. Known

only from Isla de Cozumel, it is related to *S. meridana* (Morelet, 1849) and *ventrosula* (Morelet, 1849, from Yucatán).

Genus *EUGLANDINA* Fischer & Crosse, 1870

Euglandina cylindracea (Phillips, 1846)

Glandina (*Achatina*) *cylindracea* Phillips, 1846, p. 67, pl. 1, Fig. 33.

Oleacina cylindracea Tryon, 1885, p. 41, pl. 8, Fig. 12.

Euglandina cylindracea Pilsbry, 1908, p. 198.—Richards, 1937, p. 251.

One broken specimen of this common Yucatán species was found by Richards near San Miguel, Isla de Cozumel.

Family HELMINTHOGLYPTIDAE

Genus *AVERELLIA* Ancey, 1887

Subgenus *TRICHODISCINA* Martens, 1892

Averellia (*Trichodiscina*) *coactiliata* (Deshayes, 1839)

Helix coactiliata Deshayes, 1839, p. 18, pl. 72, Figs. 1-5.

Helix (*Patula*) *coactiliata* Fischer & Crosse, 1872, p. 234 (exc. var.).

Averelia [*sic*] (*Trichodiscina*) *coactiliata* Richards, 1937, p. 252.

This species, found from Vera Cruz, Mexico, to Venezuela, was collected by Richards a short distance north of San Miguel, Isla de Cozumel.

ERRONEOUSLY REPORTED FROM QUINTANA ROO

Family UROCOPTIDAE

Genus *HOLOSPIRA* von Martens, 1860

Subgenus *HAPLOCION* Pilsbry, 1902

Holospira (*Haplocion*) *yucatanensis* Bartsch, 1906

Holospira (*Liostemma*) *yucatanensis* Bartsch, 1906, p. 153, pl. 3, Fig. 2.

—Bequaert & Clench, 1938, p. 257.

Haplocion yucatanensis Drake, 1952, p. 131.—Pilsbry, 1952, p. 69.

This species was described by Bartsch from two specimens supposedly collected on Isla Mujeres by E. W. Nelson and E. A. Goldman. The true locality of this species, as pointed out by R. J. Drake (1952, pp. 131-132), is around Boquillas, northern Coahuila, and the adjacent parts of southern Texas (Pilsbry, 1952, pp. 69-70).

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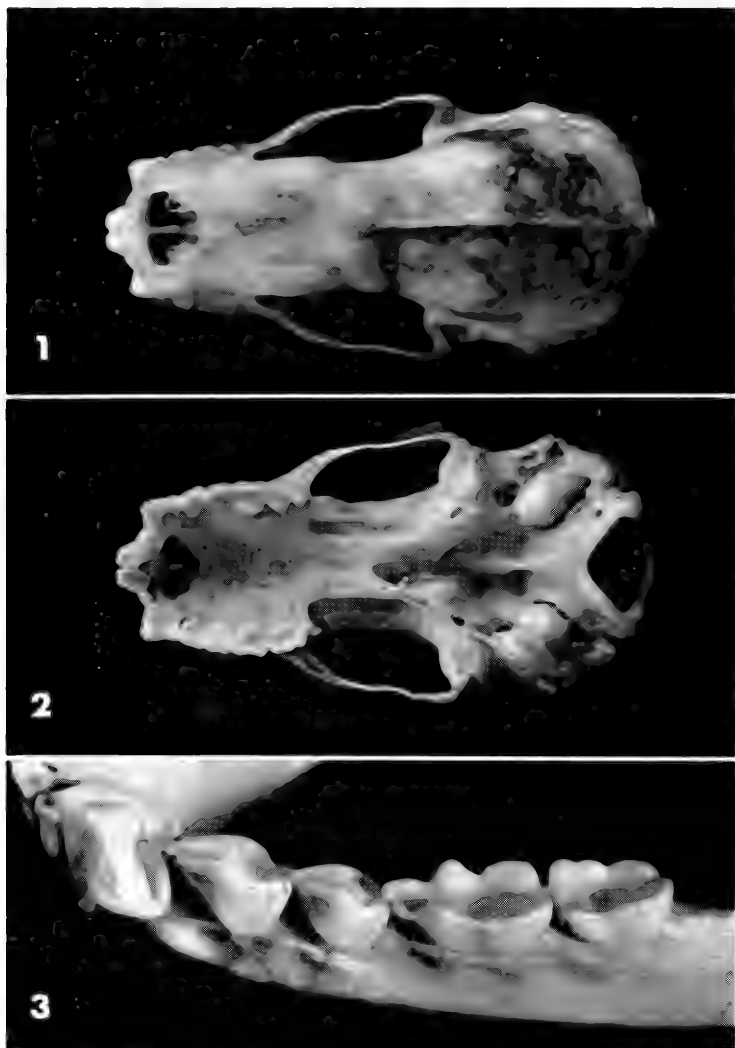
NEW SPECIES OF *STURNIRA* (CHIROPTERA: PHYL-
LOSTOMIDAE) FROM THE ISLANDS OF GUADELOUPE
AND SAINT VINCENT, LESSER ANTILLES

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33143

Although the bat fauna of the continental islands of the Caribbean has received much attention in the past, the fauna of the oceanic islands of the Lesser Antillean chain has remained poorly known. Guadeloupe and St. Vincent, for example, were discovered in 1493 and 1498 respectively but the first specimens of *Sturnira* from these islands have just been collected. Until recently, only three specimens of *Sturnira* were known from the entire Lesser Antilles—two from Dominica collected in 1906 and one from Martinique taken in 1925. Yet, the Lesser Antilles are of unique biological interest. Since their fauna shares some genera with the fauna of the American mainland, these islands offer an ideal laboratory-like situation for studying evolution in small populations isolated from a large, widespread, and probably parental population.

During the last six years the junior author and his co-workers have been studying mainly the herpetological fauna of the West Indies. However, incidental to these studies this field group has succeeded in making a collection of the bats inhabiting some of the Lesser Antilles. The *Sturnira* from these islands are of great interest since in dental and cranial morphology, at least, they differ significantly from the continental species. The relatively high degree of morphological differentiation that has occurred in different directions in Dominica, Guadeloupe, and St. Vincent offers a unique example of the effect of insular isolation in this characteristically continental genus of phyl-



FIGS. 1-3. *Sturnira thomasi*, USNM 361883 ♂, holotype: 1, dorsal view of skull ($\times 2.7$); 2, ventral view of skull ($\times 2.7$); 3, lateral view of left mandibular tooth row ($\times 10.5$).

lostomids. The distinct species *S. angeli*, which occurs in Dominica and Martinique, has been previously described (de la Torre, 1966). Two additional species, one from Guadeloupe and the other from St. Vincent, are described in this paper.

We wish to acknowledge with grateful thanks the valuable and interested assistance rendered by Ronald F. Klinikowski, Dennis R. Paulson, and Richard Thomas, in the course of these studies on the fauna of the West Indies.

The method employed in photographing the mandibular dentitions in this and in the paper cited above has been described elsewhere (de la Torre and Dysart, 1966).

***Sturnira thomasi*, new species**

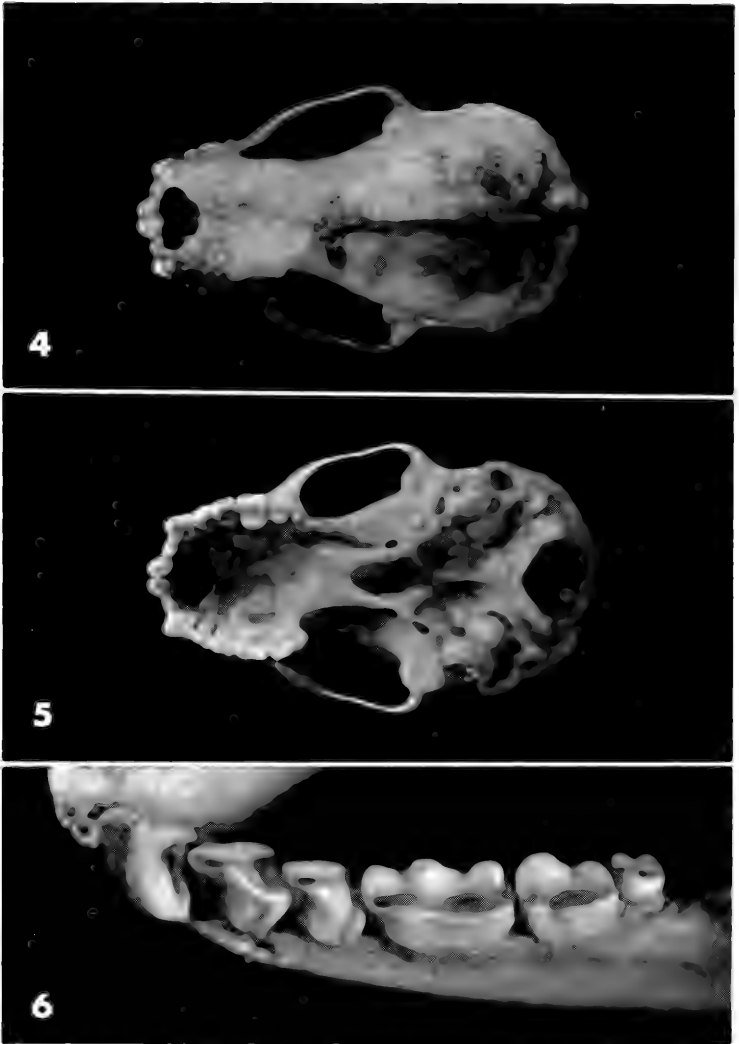
Figs. 1-3

Holotype: Adult male, skin and skull no. 361883, United States National Museum, from Sofaia, 1200 ft, Guadeloupe, French Leeward Islands, Lesser Antilles, collected by R. Thomas, 26 January 1963, original no. ASFS 5413.

Distribution: Known only from the island of Guadeloupe.

Diagnosis: A species of *Sturnira* of relatively large size; skull long and narrow; upper tooth rows very long (7.7 mm), practically parallel to each other; lower middle incisors (I_1) trilobed; M_1 with distinct paraconid, metaconid and entoconid; M_3 absent.

Description: Color of dorsum dark golden brown; basal band of hair narrow ($\frac{1}{2}$ mm) and white, epibasal band ($2\frac{1}{2}$ mm) pale grayish-brown, subterminal band (3 mm) yellowish-buff, terminal band (2 mm) dark yellowish-brown. Underparts yellowish-buff with thick, silky hair; base of hair white, subterminal band ($2\frac{1}{2}$ mm) grayish-brown, terminal band (3 mm) yellowish-brown. Posterior edge and ventral part of interfemoral membrane heavily furred; tibia and foot sparsely haired. Skull long with small, narrow braincase: rostrum long and tubular; frontal sinuses large; part of frontal bone housing sinus inflated, bulging conspicuously dorsally and laterally. Upper middle incisors (I^1) broad and strongly developed; upper premolars with lingual cingulum well developed, occlusal surface therefore large; anterior-posterior length of P^2 , M^1 , and M^2 relatively long in comparison with their width; labial cusps of M^1 and M^2 forming sharp cutting edge; protocone and metacone of M^1 widely separated, interconnecting commissure shallow; M^3 small and not occluding with lower teeth. Lower middle incisors (I_1) trilobed, lateral incisors (I_2) bilobed; premolars and molars relatively large; paraconid of M_1 low but well developed, extending anteriorly as a low ledge; metaconid and entoconid well developed, interconnecting commissure deeply notched; M_2 with anterior lingual cusp probably representing partially fused paraconid and protoconid (as occurs occasionally in *S. lilium*); M_3 absent.



FIGS. 4-6. *Sturnira paulsoni*, USNM 361882 ♀, holotype: 1, dorsal view of skull ($\times 2.7$); 2, ventral view of skull ($\times 2.7$); 3, lateral view of left mandibular tooth row ($\times 10.5$).

Comparisons: The dorsal view of the skull of *S. thomasi* bears a superficial resemblance to that of *S. mordax* Goodwin from Costa Rica. However, examination of the lower dentition will immediately differentiate the two (lingual cusps of M_1 and M_2 well developed in *S. thomasi* but greatly reduced in *S. mordax*). The length of the upper tooth row (7.7 mm) will distinguish *S. thomasi* from all other species with the exception of the giant *S. magna* de la Torre from Perú (upper tooth row, 7.3–7.9 mm). The highly cuspidate molars and the smaller size of *S. thomasi* (forearm, 48.1; skull, 26.2) will easily differentiate this species from the larger *S. magna* (forearm, 57.4; skull, 28.7). The long, narrow skull, long maxillary tooth rows, cuspidate molars, and presence of only two mandibular molars will distinguish *S. thomasi* from all other species.

Remarks: *S. thomasi* is the only species of *Sturnira* lacking the M_3 . Although reduction in the number of teeth is usually associated with a shortening of the anterior part of the skull, this is not the case in *S. thomasi*. As described above, it has a long rostrum and long tooth rows. The mandible is long and space seems available for a third molar in spite of the relatively large size of M_1 and M_2 . Additional specimens will be necessary before one may discount the possibility of this representing an anomalous absence of the M_3 .

The holotype was the only specimen taken in a net set in a deep ravine at Sofaia. At this location the torrential, boulder-strewn Rivière Salée has a width of about twelve feet and cuts through an area of extremely dense forest with no adjacent cultivated areas whatsoever.

This unique species is named in honor of its collector, Richard Thomas.

Measurements: Measurements of holotype (in mm): forearm, 48.1; metacarpal III, 46.2, phalanx 1, 17.7, phalanx 2, 23.3; metacarpal IV, 45.9, phalanx 1, 15.0; metacarpal V, 48.3, phalanx 1, 10.6; greatest skull length, 26.2; condylobasal length, 24.7; zygomatic breadth, 12.7; mastoid breadth, 12.1; palatal length, 11.6; interorbital constriction, 6.3; post-orbital constriction, 6.0; maxillary tooth row, 7.7; maxillary width, 8.2; mandible, 16.8; mandibular tooth row, 7.8. Collector's field measurements are as follows: forearm, 47; head and body, 80; foot, 16; ear, 18; tragus, 6.

Specimens examined: The holotype is the only known specimen.

***Sturnira paulsoni*, new species**

Figs. 4–6

Holotype: Adult female, skin and skull no. 361882, United States National Museum, from Lowrt, 1000 ft, St. Andrew Parish, Saint Vincent, British Windward Islands, Lesser Antilles, collected by D. R. Paulson, 30 December 1961, original no. ASFS 5333.

Distribution: Known only from the island of St. Vincent.

Diagnosis: A species of *Sturnira* of small size; skull small, narrow, and delicate; braincase high but narrow; rostrum relatively long; M^1 with widely separated protocone and paracone, interconnecting commissure

shallow; M_1 with paraconid, metaconid, and entoconid in linear sequence one behind the other; paraconid (of M_1) therefore displaced much more lingually than in all other species of *Sturnira*; metaconid and entoconid (of M_1) relatively low and rounded, not ridge-like as in *S. lilium*; entoconid of M_2 about a third the size of metaconid; lower incisors trilobed.

Description: Color of dorsum pale grayish-brown; basal band of hair white and narrow ($\frac{1}{2}$ mm), epibasal band (2 mm) dull grayish-brown, subterminal band (3 mm) pale buff, terminal band ($1\frac{1}{2}$ mm) dark grayish-brown. Underparts dark yellowish-buff with long, thick, silky hair; base of hair white, subterminal band (3 mm) dark yellowish-brown, terminal band ($3\frac{1}{2}$ mm) yellowish-buff. Hind limbs, posterior edge and ventral part of interfemoral membrane heavily furred. Skull small, delicate, and narrow; rostrum relatively long; braincase as seen from posterior aspect, high and narrow; upper tooth rows arching symmetrically as in *S. lilium*; M^1 relatively large, with widely separated protocone and paracone; protocone-paracone commissure of M^1 shallow, not deep as in *S. lilium*. Lower incisors trilobed, with lateral lobes better developed than median lobe; labial cusps of lower molars relatively low and rounded, not forming a high, sharp ridge as in *S. lilium* (occlusal surface, therefore, flatter and more horizontal than in *S. lilium*); M_1 long and rectangular, paraconid relatively high and displaced medially (its main axis coinciding with longitudinal axis of metaconid and entoconid); entoconid of M_1 relatively small, least developed of lingual cusps; metaconid of M_2 very large, about three times size of entoconid.

Comparisons: The morphology of the molars will distinguish *S. paulsoni* from all known species. It is closer in morphology to *S. lilium*. However, the details of M^1 , M_1 , and M_2 as described above will distinguish *S. paulsoni* from *S. lilium*.

Remarks: The holotype was trapped in a net across a 20-feet wide mountain stream, a tributary of the Dalaway River, at Lowrt in an area adjacent to rain forest. Presumably the immediate area had been originally forested, but cultivation has opened up the region along the river. The forest now stands about 100 feet from the bank of the river. No other bats were taken in the net at this particular locality, although at night *Artibeus* were seen foraging in fruit trees near the net and along the river. A sandpiper, *Actitis macularia*, was caught in the bottom of the net on the same night that *S. paulsoni* was taken. Apparently it too had been foraging along the stream and had flown into the net.

S. paulsoni is named in honor of its collector, Dennis R. Paulson, whose efforts and interest are responsible for the finding of this species.

Measurements: Measurements of holotype (in mm): forearm, 41.0; metacarpal III, 40.0, phalanx 1, 14.8, phalanx 2, 18.0; metacarpal IV, 39.8, phalanx 1, 12.3; metacarpal V, 41.1, phalanx 1, 8.7; greatest skull length, 22.1; condylobasal length, 19.8; zygomatic breadth, 12.7; mastoid breadth, 11.2; palatal length, 9.6; interorbital constriction, 5.7; postorbital constriction, 5.7; maxillary tooth row, 6.5; maxillary width, 7.8; man-

dible, 14.1; mandibular tooth row, 7.1. Collector's field measurements are as follows: forearm, 42; head and body, 64; foot, 11; ear, 16; tragus, 6.

Specimens examined: The holotype is the only specimen known.

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DICAEUM PROPRIUM, NEW SPECIES
(AVES; FAMILY DICAUIDAE)

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Intensive ornithological collecting in the Philippine Islands during recent years has yielded a number of unusual birds, including a new genus and several new species. Two male birds collected on Mindanao represent a remarkable new flowerpecker which differs from all other known species of the family in the color of the underparts. This new species we propose to call:

Dicaeum proprium, new species

Holotype: adult male, USNM No. 519079, collected 2 July 1965 on Mount Mayo at Limot, Mati, Davao Province, Mindanao by D. S. Rabor.

Diagnosis: differs from all other species of *Dicaeum* in that the underparts are slate grey slightly washed with sepia, most noticeably on the chest and flanks. The chin, malar stripe, central abdomen, and undertail coverts are greyish white. There are concealed whitish tufts on the sides of the abdomen high up under the wings. The upper parts and the submalar moustachial streak are dark metallic bluish black, characteristic for males of the family.

The greyish-white malar streak outlined by the dark submalar moustachial streak is found in five of the six species of *Prionochilus* Strickland (= *Anaimos* Reichenbach) but in only one other member of the genus *Dicaeum* Cuvier. This new species belongs in *Dicaeum*, however, because the tenth primary is vestigial rather than relatively large as in *Prionochilus* and the bill is thinner and more abruptly pointed as is more typical of *Dicaeum*. The female plumage is unknown.

Measurements: two males, wing 62 mm (2); tail 26 (holotype), 29; culmen 11 (holotype), 9.5. Weight 10.2, 10.2 gm.

Remarks: *Dicaeum proprium* is unlike any other known flowerpecker. The moustachial streak is perhaps an indication of a primitive trait in the genus relating it to such species as *Prionochilus percussus* (Temminck and Laugier), although otherwise it differs completely in its drab underparts and lack of a bright crown patch. The presumably

primitive character of the moustachial streak, however, may point to a Greater Sunda Islands origin where most species of *Prionochilus* occur.

Range: known only from Mount Mayo, southeastern Mindanao Island, Philippines.

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(New names in **boldface**; see p. v for list of authors.)

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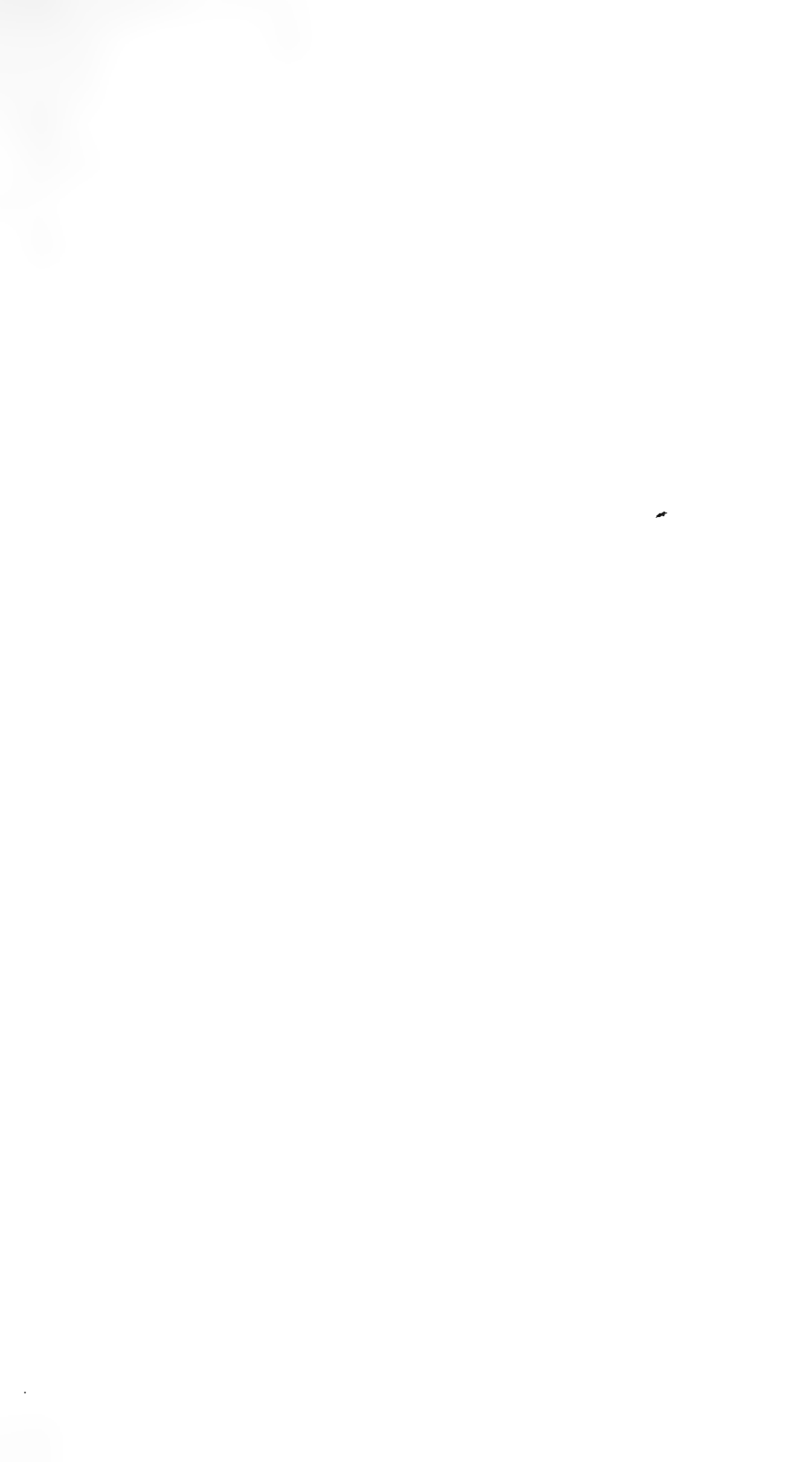
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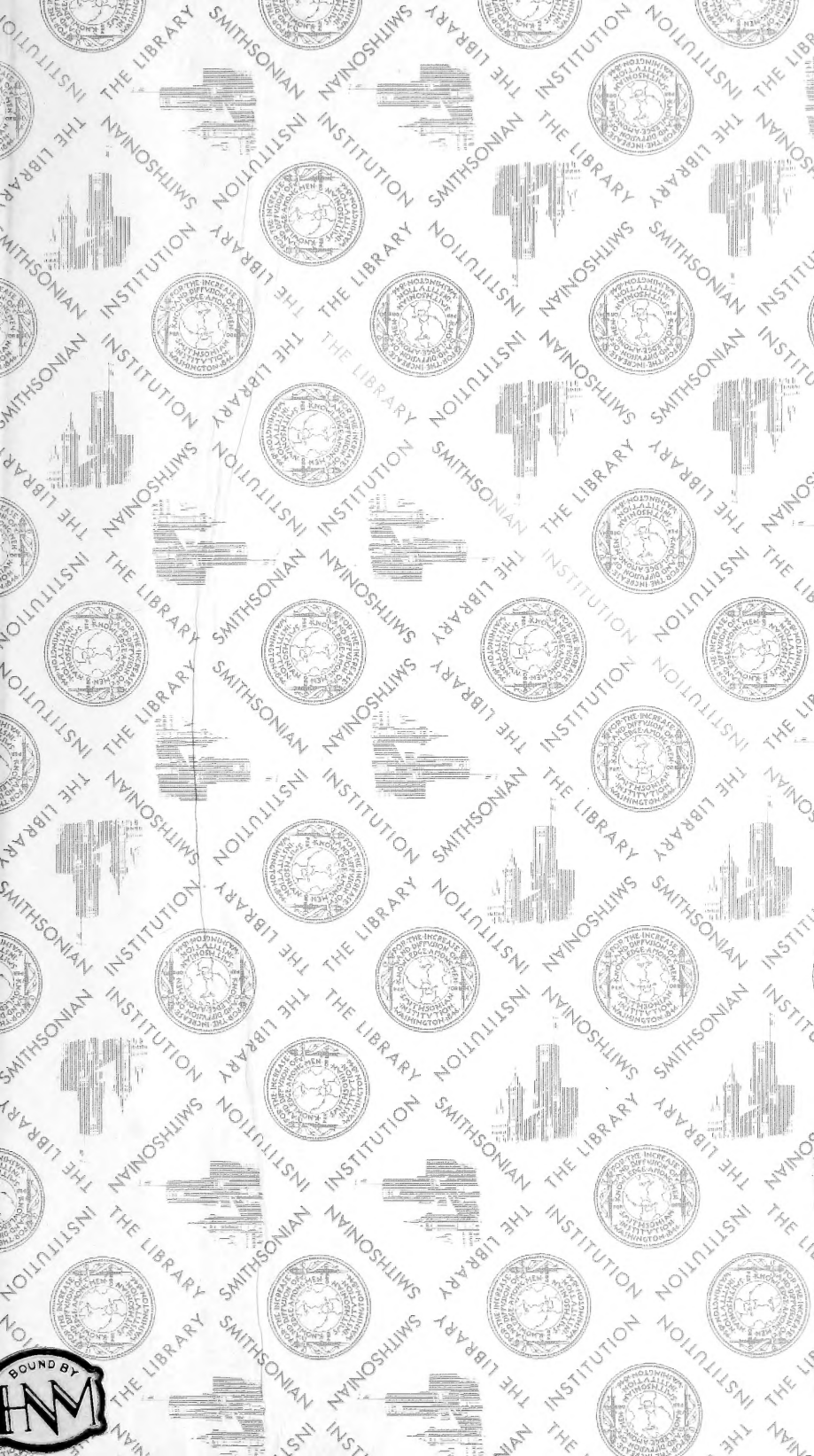












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